# PROPAQ encore®

## Service Manual

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# UPDATE

## Propaq CS® Service Manual

Update for Software Versions 3.3X

## Propaq Encore® Service Manual

Update for Software Versions 2.3X

WelchAllyn®

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# Contents

**About this Update. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 4**

**General Warnings and Cautions. . . . . . . . . . . . . . . . . . . . . . . . . . . . 5**

**Identifying Propaq Monitor Configurations. . . . . . . . . . . . . . . . . . . . 6**

**Functional Verification. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 7**
Functional Verification for Masimo SpO2 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 7
Functional Verification for Nellcor SpO2. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 8

**Repair Procedures . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 9**
Replacing the SpO2 Boards . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 9

**Technical Overview . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 9**
Pulse Oximetry Option (SpO2) Description . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 9

# About this Update

This Update provides information to help maintain and repair the Propaq® CS monitor or Propaq® Encore monitor with one of the following Pulse Oximetry ($SpO_2$) options installed in a monitor Baqpaq or Expansion Module:

- Masimo® Pulse Oximetry
- Nellcor® Pulse Oximetry with motion tolerance (MP405)
- Nellcor® Pulse Oximetry (MP203)

These options are available for use with the Propaq CS monitor (software version 3.3X) or Propaq Encore monitor (software version 2.3X).

For all other service information for these monitors, refer to these documentation kits:

| | |
|---|---|
| • 810-1315-XX | Propaq CS 3.XX Service Manual Kit |
| • 810-1316-XX | Propaq Encore 2.XX Service Manual Kit |

For operating information for these monitors, refer to these documentation kits:

| | |
|---|---|
| • 810-1102-XX | Propaq CS 3.XX Directions For Use Kit |
| • 810-0867-XX | Propaq Encore 2.XX Reference Guide Kit |

# General Warnings and Cautions

Familiarize yourself with all warnings and cautions contained in the Service Manual Kits listed above, and with the following warnings and cautions before attempting to repair or maintain the Propaq monitor.

***Warning***

Do not operate this product in the presence of flammable anesthetics or other flammable substance in combination with air, oxygen-enriched environments, or nitrous oxide; explosion can result.

The pulse oximetry channel should NOT be used as an apnea monitor.

This monitor is to be operated by qualified personnel only. The operator of this monitor should read this entire manual, the monitor *Reference Guide* or *Directions For Use*, and all accessory *Directions For Use* before operating the monitor.

This monitor should only be repaired by qualified service personnel. The operator should not attempt to open the monitor case or perform any maintenance on the monitor except for procedures explicitly described in this manual that can be performed by operators such as inspection and cleaning.

When using a power adapter with this monitor, be sure to connect the power adapter to a three-wire, grounded, hospital-grade receptacle. Do not under any circumstances attempt to remove the grounding conductor from the power plug of the power adapter. Do not plug the power adapter into an extension cord. If there is any doubt about the integrity of the protective earth ground of the receptacle for the power adapter, do not plug in the power adapter; operate the monitor only on battery power. Contact your biomedical engineering department for assistance in identifying the proper power receptacle and making appropriate power connections.

Place the Propaq monitor and accessories in locations where they cannot harm the patient if they fall from their shelf or mount. Lift the monitor only by its handle; do not lift it by any attached cables.

Safe interconnection between the Propaq monitor and other devices must comply with applicable medical systems safety standards such as IEC 60601-1-1. Within certain governmental jurisdictions, all interconnected accessory equipment must be labeled by an approved testing laboratory. After interconnection with accessory equipment, risk (leakage) current and grounding requirements must be maintained.

As with all medical equipment, carefully route the patient cabling to reduce the possibility of patient entanglement or strangulation.

# Identifying Propaq Monitor Configurations

The following table identifies Propaq monitor configurations and how they are indicated. The model-option number and serial number are located on the back of the housing. The monitor indicators are located under the handle on the back.

**Propaq Monitor Configurations**

| Product (Housing) | Model Number | Option Number | Parameters Included (Acuity Option Is Also Available With Every Model) |
|---|---|---|---|
| PROPAQ CS MONITOR | 242 | | ECG, NIBP, 2 TEMP., RESP. OPTION, NURSE CALL OPTION, COLOR DISPLAY |
| | 244 | | ECG, NIBP, 2 TEMP., 1 IBP, RESP. OPTION, NURSE CALL OPTION, COLOR DISPLAY |
| | 246 | | ECG, NIBP, 2 TEMP., 2 IBP, RESP. OPTION, NURSE CALL OPTION, COLOR DISPLAY |
| PROPAQ ENCORE MONITOR | 202-EL | | ECG, NIBP, 2 TEMP., RESP. OPTION, EL DISPLAY |
| | 204-EL | | ECG, NIBP, 2 TEMP., 1 IBP, RESP. OPTION, EL DISPLAY |
| | 206-EL | | ECG, NIBP, 2 TEMP., 2 IBP, RESP. OPTION, EL DISPLAY |
| $SPO_2$-ONLY MODULE | | 210 | $SPO_2$<br>THREE OPTIONS AVAILABLE:<br>Nellcor MP-405 (Top level assembly 007-0059-XX)<br>Nellcor MP-203 (Top level assembly 007-0020-XX)<br>Masimo MS3 (Top level assembly 007-0060-XX) |
| EXPANSION MODULE | See next table | | |

**Expansion Module Option Configurations**

| Option Number | Printer | Mainstream $CO_2$ | Sidestream $CO_2$ | $SpO_2$ | Top Level Assembly Number |
|---|---|---|---|---|---|
| 221 | Yes | No | No | N/A | 007-0046-XX |
| 222 | No | No | No | Nellcor MP-203 | 007-0050-XX |
| 223 | Yes | No | No | Nellcor MP-203 | 007-0047-XX |
| 223 | Yes | No | No | Nellcor MP-203 | 007-0051-XX |
| 223 | Yes | No | No | Masimo MS3 | 007-0069-XX |
| 223 | Yes | No | No | Nellcor MP-405 | 007-0086-XX |
| 224 | No | Yes | No | Nellcor MP-203 | 007-0049-XX |
| 224 | No | Yes | No | Masimo MS3 | 007-0070-XX |
| 224 | No | Yes | No | Nellcor MP-405 | 007-0085-XX |
| 225 | Yes | Yes | No | Nellcor MP-203 | 007-0048-XX |
| 225 | Yes | Yes | No | Masimo MS3 | 007-0071-XX |
| 225 | Yes | Yes | No | Nellcor MP-405 | 007-0084-XX |
| 226 | No | No | Yes | Nellcor MP-203 | 007-0045-XX |
| 226 | No | No | Yes | Masimo MS3 | 007-0072-XX |
| 226 | No | No | Yes | Nellcor MP-405 | 007-0083-XX |
| 227 | Yes | No | Yes | Nellcor MP-203 | 007-0043-XX |
| 227 | Yes | No | Yes | Masimo MS3 | 007-0073-XX |
| 227 | Yes | No | Yes | Nellcor MP-405 | 007-0082-XX |
| 228 | No | Yes | Yes | Nellcor MP-203 | 007-0052-XX |
| 228 | No | Yes | Yes | Masimo MS3 | 007-0074-XX |
| 228 | No | Yes | Yes | Nellcor MP-405 | 007-0081-XX |
| 229 | Yes | Yes | Yes | Nellcor MP-203 | 007-0044-XX |
| 229 | Yes | Yes | Yes | Masimo MS3 | 007-0075-XX |
| 229 | Yes | Yes | Yes | Nellcor MP-405 | 007-0080-XX |

# Functional Verification

## Functional Verification for Masimo $SpO_2$

This functional verification procedure helps to confirm the proper operation of the Masimo Pulse Oximetry option installed in the Propaq monitor. This procedure supports the requirements of routine preventive maintenance. No monitor disassembly is required to perform this procedure.

You will need the following equipment to perform this procedure.

- Masimo-compatible $SpO_2$ cable:
  008-0580-00 $SpO_2$ cable, 4 feet, Masimo-compatible
  008-0692-00 $SpO_2$ cable, 8 feet, Masimo-compatible
- Compatible adult $SpO_2$ sensor for finger.
- BIO-TEK Index 2 Series $SpO_2$ Simulator with optical finger for sensor connection (or equivalent).

1. Turn on power to the $SpO_2$ simulator.
2. Connect the $SpO_2$ cable to the monitor and the $SpO_2$ sensor.
3. Apply the $SpO_2$ sensor to the $SpO_2$ simulator optical finger.
4. Set the simulator manufacturer type ("MAKE") to Masimo.
5. Set the simulator output to $SpO_2$ saturation 94% and pulse rate 60 beats per minute (with no motion artifact selected).

   Confirm that the monitor displays $SpO_2$ data and the pulse amplitude indicator is moving.

   Confirm that the displayed saturation is 94% ±4 counts, and the displayed pulse rate is 60 ±4 bpm.
6. Disconnect the sensor from the simulator and cable, and disconnect the $SpO_2$ cable.

## Functional Verification for Nellcor $SpO_2$

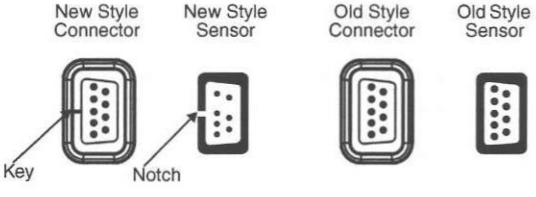
This functional verification procedure helps to confirm the proper operation of the Nellcor Pulse Oximetry option installed in the Propaq monitor. This procedure supports the requirements of routine preventive maintenance. No monitor disassembly is required to perform this procedure.

You will need the following equipment to perform this procedure.

- Nellcor-compatible adult SpO2 finger sensor
- BIO-TEK Index 2 Series $SpO_2$ Simulator with optical finger for sensor connection (or equivalent).

**Note**

Older style Nellcor sensors and extension cables are not compatible with the connector on the Nellcor option with motion tolerance (Nellcor MP-405), and cannot be plugged into it. However, new style Nellcor sensors and extension cables can be used with all Nellcor options, and can be plugged into either the old or new style connectors. The new style sensor and connector can be identified by a "notch" and "key" as shown.



1. Turn on power to the $SpO_2$ simulator.
2. Connect the SpO2 sensor to the monitor and apply to the SpO2 simulator optical finger.
3. Set the simulator manufacturer type ("MAKE") to Nellcor.
4. Set the simulator output to $SpO_2$ saturation 94% and pulse rate 60 beats per minute (with no motion artifact selected).

   Confirm that the monitor displays $SpO_2$ data and the pulse amplitude indicator is moving.

   Confirm that the displayed saturation is 94% ±4 counts, and the displayed pulse rate is 60 ±4 bpm.
5. Disconnect the sensor from the simulator.

# Repair Procedures

## Replacing the $SpO_2$ Boards

This procedure is the same as described in the *Propaq CS Service Manual* (p. 105) and *Propaq Encore Service Manual* (p. 109) except for the following change:

Step 5: There is only one screw securing the SCP Board and Masimo SpO2 Board to the rear panel.

# Technical Overview

## Pulse Oximetry Option ($SpO_2$) Description

The monitor pulse oximetry option ($SpO_2$) hardware includes two circuit boards, a side-panel connector, and related hardware. The pulse oximetry option is installed in the pulse oximetry option module attached to the rear of the monitor (also known as the Baqpaq) or the expansion module when the printer or the $CO_2$ option are also present.

The two circuit boards include the $SpO_2$ Communications Processor (SCP Board) and the $SpO_2$ Board. The $SpO_2$ Board provides all necessary circuitry to receive and process oxygen saturation data from the oxygen sensor. The SCP Board prepares the data for processing by the monitor's processor, and it handles all communications with the monitor. The SCP Board also drives the $SpO_2$ speaker.

The $SpO_2$ option hardware consists of the following items:

- monitor/option interface circuit board (SCP Board)
- $SpO_2$ Board
- side-panel connector
- $SpO_2$ speaker
- the $SpO_2$ case attached to the rear of the monitor when no expansion module is present
- when a printer is present, the expansion module case attached to the bottom of the monitor

The $SpO_2$ signal provided by the oxygen transducer or sensor is first processed by the $SpO_2$ Board where it is converted to digital data, then that data is passed to the SCP Board where it is prepared for transmission to the monitor's main microprocessor.

An $SpO_2$ option isolated power supply, powered by monitor batteries, resides on the SCP Board, supplying power to the $SpO_2$ circuits only.

A connector on the side panel allows connection of an oxygen transducer directly to the monitor.

The oxygen transducer senses oxygen content of functional arteriolar hemoglobin through the use of light passed through the sensor site. The reflective/absorbtive characteristics of hemoglobin at the wavelengths used allow the pulse oximetry circuits to obtain changing saturation levels, which can be processed to obtain the oxygen saturation percentage.

Wavelengths in the red and the infrared regions of light are produced by light emitting diodes (LEDs) manufactured to emit light at the required wavelengths. The reflected light is detected by a photo diode, which converts the light to an electrical signal. The LEDs are switched on and off under control of the $SpO_2$ microprocessor. Both are not on at the same time. As the system receives the signal from the photo diode, it knows whether the signal was derived from the red or infrared LED. Because the photo diode is sensitive to light emitted from sources other than the LEDs (ambient light), an ambient light component is subtracted from the signal during the processing of the $SpO_2$ data.

***Note***

The oxygen transducers are not serviceable units.

# Field Replaceable Units (FRUs)

This table lists the available FRUs for the Pulse Oximetry Option (Masimo or Nellcor) that can be installed in the Baqpaq (rear-panel $SpO_2$ option) and Expansion Module for Propaq CS and Propaq Encore monitors.

| REPLACEMENT PART DESCRIPTION | PART NO. |
|---|---|
| **PULSE OXIMETRY OPTION** | |
| SpO2 BOARD, NELLCOR MP-203 | 020-0473-00 |
| SpO2 BOARD, MASIMO MS3 | 031-0129-00 |
| SpO2 BOARD, NELLCOR MP-405 | 031-0130-00 |
| SCP BOARD, NELLCOR MP-203, 1XX/20X/24X | 020-0476-00 |
| SCP BOARD, NELLCOR/MASIMO<br>20X (SW VERSIONS 2.20.00 & GREATER)<br>24X (SW VERSIONS 3.20.00 & GREATER) | 031-0133-01 |
| CASE, SpO2-ONLY MODULE, FRONT, NELLCOR/MASIMO | 020-0122-01 |
| CASE, SpO2-ONLY MODULE, REAR, NELLCOR/MASIMO | 020-0123-01 |
| MOUNTING SCREWS/WASHERS | 020-0126-00 |
| SPEAKER PANEL ASSY., ALL | 010-0161-00 |
| CONNECTOR PANEL ASSY., NELLCOR MP-203, (LOCK. RING NOT INCL.) | 010-0159-00 |
| LOCKING RING, D-CONNECTOR, NELLCOR (FOR NELLCOR MP-203 ONLY) | 630-0038-00 |
| CONNECTOR PANEL ASSY., MASIMO MS-3 | 010-0208-00 |
| CONNECTOR PANEL ASSY., NELLCOR MP-405 | 010-0210-00 |
| **LABELS, ALL LANGUAGE APPLICATIONS** | |
| LABEL, SpO2 CONNECTOR SIDE PANEL (NELLCOR MP-203 ONLY) | 640-0443-00 |
| LABEL, REAR PANEL (STAND-ALONE MONITOR, BAQPAQ) | 640-0331-06 |
| LABEL, REAR PANEL (EXPANSION MODULE) | 640-0385-05 |

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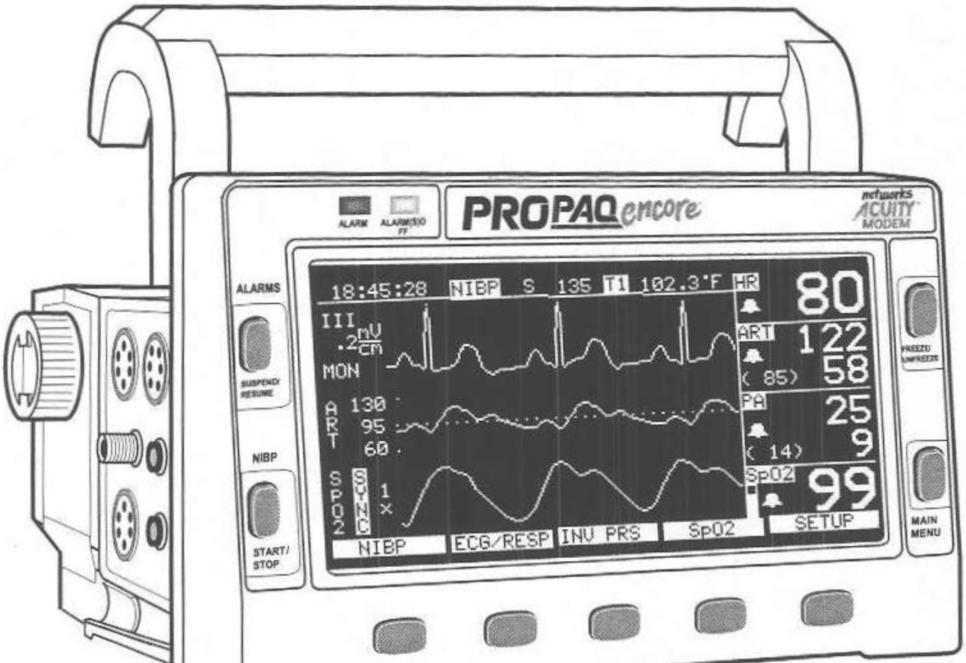
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FREEZE/ UNFREEZE
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## Contents

### Safety Summary

Important Safety Considerations ........ 11
Definitions ........ 12
Symbols ........ 13

### Section 1
### Overview

Purpose and Scope ........ 15
Other Applicable Documents ........ 15
Unpacking Procedure ........ 16
Warranty Service ........ 16
Technical Support Services ........ 16
Recommended Service Intervals ........ 18
Identifying Propaq Encore Configurations ........ 19
Self Test and Service Menus ........ 19

### Section 2
### Functional Verification

Introduction ........ 21
    Self Tests ........ 21
Safety Tests ........ 23
    Risk (Leakage) Current Test ........ 23
    Dielectric Strength (Hi-Pot) Test ........ 24
Functional Verification ........ 25
    Power System ........ 25
    System Tests ........ 27
    ECG/RESP Channel & Alarm Indicators ........ 28
    IBP ........ 30
    NIBP ........ 32
    Temperature ........ 34
    $SpO_2$ Checks ........ 34
    Printer Tests ........ 35
    $CO_2$ Verification Preparation ........ 36
    Mainstream $CO_2$ Verification Procedure ........ 40

## Section 3
## Calibration

Introduction ..... 47
Equipment Needed ..... 48
Procedures ..... 49
    Setup ..... 49
Recharger Supply Adjustments ..... 50
Display Voltage Adjustments ..... 53
Main Power Supply Adjustments ..... 54
Calibrating Realtime ECG Out ..... 56
Non-Invasive Blood Pressure Calibration ..... 57
EMI Null Adjustment ..... 59
Invasive Blood Pressure ..... 59
    MSP Board ($MCO_2$) Calibration ..... 60

## Section 4
## Troubleshooting

Introduction ..... 61
Screen Messages ..... 61
    Non-Recoverable Error Codes ..... 62
Battery Capacity Check ..... 63

## Section 5
## Repair Procedures

Introduction ..... 65
Propaq Encore Software ..... 65
Required Tools ..... 66
    Propaq Encore Options ..... 67
Field Replaceable Units in the Monitor ..... 67
Replacing the Power Input Fuse ..... 70
Replacing the Battery Pack ..... 71
    Removing the Single Battery Pack ..... 72
    Removing the Dual Battery in Expansion Module ..... 73
    Removing the Dual Battery in $SpO_2$ Module ..... 75
Opening the Monitor ..... 75
Closing the Monitor ..... 79
Replacing the Analog Board ..... 80
Replacing the Digital Board ..... 82
Replacing the EL Display Module ..... 85
Removing Front Panel Buttons ..... 88
Replacing Recharger Board Fuse (F2) ..... 90
Replacing Air Tubing ..... 91
Replacing Cables ..... 91
Replacing PROMs ..... 92
    Cuff Fittings ..... 93

Replacing the Recharger Board .......... 94
Replacing the Pump .......... 97
Replacing the Side Panels .......... 98
  Removing the Right Side Panel .......... 98
  Removing the Left Side Panel .......... 99
  Installing Side Panels .......... 99
Expansion Module .......... 101
  Opening Expansion Module Rear Panel .......... 102
  Closing Expansion Module .......... 103
Replacing Expansion Module Front Panel .......... 104
Replacing Expansion Module Button Board and Buttons .......... 106
Replacing the Printer .......... 106
  Removing Printer .......... 106
  Installing Printer .......... 108
Opening the $SpO_2$ Module .......... 110
Replacing the $SpO_2$ Circuit Boards .......... 113
Replacing the MSP/$SpO_2$ Circuit Boards .......... 114
Replacing the Sidestream $CO_2$ Assemblies .......... 116
  Replacing the extender board .......... 116
  Removing the SSP/Stick board assembly: .......... 116
  Removing the Stick board from the SSP board: .......... 117
Replacing Expansion Module Side Panels .......... 119

## Section 6
## Technical Overview

System Description .......... 121
  Power Electronics Description .......... 128
  Monitoring Electronics System Description .......... 130
  NIBP Pneumatics Description .......... 132
Cabling Diagrams .......... 137
Expansion Module and Printer Description .......... 139
Pulse Oximetry Option ($SpO_2$) Description .......... 141
Capnography ($CO_2$) Description .......... 144
  Mainstream Board .......... 145
  IPC Expansion .......... 146
  Power Distribution System .......... 146
  $CO_2$ Analysis Chamber (Bench) .......... 146

## Section 7
## Field Replaceable Units (FRUs)

List of FRUs .......... 147

## Appendix A
## Manufacturable Test Equipment

Introduction .......... 153

## Appendix B
## Dynatech/Nevada Patient Simulator Modification

Introduction .......... 155

# Safety Summary

This Safety Summary should be read by all Propaq Encore users. Specific warnings and cautions will be found throughout the documentation where they apply.

Caution: Federal (U.S.A.) law restricts this device to sale, distribution, or use by or on the order of a licensed medical practitioner.

## Important Safety Considerations

Please consider the following safety points when using the Propaq.

- Place the Propaq Encore and accessories in locations where they cannot harm the patient should they fall from their shelf or mount.
- Do not connect more than one patient to a monitor. Do not connect more than one monitor to a patient.
- Do not use the Propaq Encore in an MRI suite or a hyperbaric chamber.
- Do not autoclave the Propaq Encore. Autoclave accessories only if the manufacturer's instructions clearly approve it. Many accessories can be severely damaged by autoclaving.
- Inspect the power adapter cord periodically for fraying or other damage, and replace the adapter as needed. Do not operate the apparatus from mains power with a damaged power adapter cord or plug.
- Make frequent electrical and visual checks on cables and electrode wires.
- Avoid electrosurgery burns at monitoring sites by ensuring proper connection of the electrosurgery return circuit so that the return paths cannot be made through monitoring electrodes and probes.
- During defibrillation, keep the discharge paddles away from ECG and other electrodes, as well as other conductive parts in contact with the patient. Avoid contact with any accessories connected to the Propaq's left side panel.
- To ensure patient safety, the conductive parts of the ECG electrodes (including associated connectors) and other patient-applied parts should not contact other conductive parts, including earth ground, at any time.
- Do not operate this product in the presence of flammable anesthetics. Explosion can result.

*note...*

**Within certain governmental jurisdictions, all interconnected accessory equipment must be labeled by an approved testing laboratory. After interconnection with accessory equipment, risk (leakage) current and grounding requirements must be maintained.**

- To ensure conformance to risk (leakage) current requirements when operating from an ac mains power source, use only a Protocol Systems' 503-0054 series power adapter.
- To ensure patient safety, use only accessories recommended or supplied by Protocol Systems, Inc. For a list of those accessories, see the Protocol *Products and Accessories* book that accompanied this manual (PN 810-0409-XX). Accessories must be used according to your hospital's standards and the manufacturer's recommendations. Always refer to the manufacturer's directions for use.
- A product that has been dropped or severely abused should be checked by qualified service personnel to verify proper operation and acceptable risk (leakage) current values.
- If the monitor detects an unrecoverable problem, an error message window appears containing an error number and a short message. Report such errors to Protocol Systems.
- The Propaq Encore should be serviced only by a Protocol Systems service technician while under warranty.

## Definitions

note...

**NOTE statements in the service manual, which look like this, identify information that may be important to the reader.**

CAUTION

**CAUTION statements in the service manual, which look like this, identify conditions or practices that could result in damage to equipment or other property.**

WARNING

**WARNING statements in the service manual, which look like this, identify conditions or practices that could result in personal injury.**

## Symbols

The following symbols appear in the Propaq documentation and on Propaq labels. These internationally recognized symbols are defined by the International Electrotechnical Commission, IEC 878 and IEC 417A.

| | | | |
|---|---|---|---|
| ⏻ | Off (Standby). | ⇄ | Two way communication port. |
| ⏼ | On. | →○ | Input port to monitor. |
| ⚠ | For continued fire protection, use only the specified fuse. | ○→ | Signal output port from monitor. |
| ⎓ | Direct current. | ∿ | Alternating current. |
| ⚠ | Caution: Refer to Reference Guide and accompanying documentation. | 🌡 | Temperature sensor input. |
| 🔋 | Battery charging when green indicator illuminated. | IPX1 | Enclosure Protection Drip proof: Classification IPX1 per IEC Publication 529. |
| ♥ | All patient connections are Type CF, isolated for direct cardiac application, and protected against defibrillation. | ⌂ | For indoor use only (on power adapter only). |
| 🚶 | All patient connections are TypeBF, and protected against defibrillation. | ⦵ | Transformer meets requirements of a short-circuit-proof safety-isolating power transformer. |
| 🚶 | All patient connections are TypeB | ♻ | Batteries must be separated from other disposables for recycling. |
| CE 0123 | The CE mark and notified body registration number signify Propaq Encore 200 Series monitors have met all essential requirements of European medical device directives 93/42/EEC. | CE | The CE mark signifies the device has met all essential requirements of European Medical Device Directive 93/42/EEC for a Class 1 product.[1] |
| SP®<br>NRTL/C<br>Evaluated to CSA 601-1<br>and UL2601-1 | The Canadian Standards Association has evaluated this device according to CSA 601-1 and Underwriters Laboratory Standard UL 2601-1.[1] | | |

---

[1] This symbol is on the Universal Power Adapter.

# Section 1
# Overview

## Purpose and Scope

The Propaq Encore Service Manual is intended as a reference for monitor maintenance and repair to the field replaceable unit (FRU) level. FRUs are listed in Section 7. This manual provides the technically qualified service person with troubleshooting information, repair procedures, and calibration and performance verification instructions. A technical overview of the monitor subsystems is provided as an introduction to the device's circuitry and pneumatics.

*note...*

**Configurations vary nationally. Some early versions of the Propaq Encore do not include impedance pneumagraphy (RESP) in some countries.**

This manual is intended for the technically qualified service person. Service training classes on Protocol Systems' products are available. Contact Protocol Technical Service for information.

## Other Applicable Documents

Several other documents are available for the Encore monitor. Refer to those documents for other than maintenance and repair information. Check the *Encore Reference Guide* for information on other user's documentation.

| Title | Part Number |
|---|---|
| Propaq Encore Reference Guide, English Language, U.S. | 810-0639-XX |
| Propaq Encore Reference Guide, English Language, International | 810-0640-XX |
| Propaq Encore Reference Guide, German Language | 810-0641-XX |
| Products & Accessories Book | 810-0409-XX |

## Unpacking Procedure

Use the following guidelines when unpacking the Encore monitor from its shipping carton.

1. Before opening the Encore monitor shipping carton, check it for damage.
2. If damage is apparent, stop unpacking the carton and contact the shipping company for further instructions. If the carton is intact, unpack the Encore monitor.
3. With the Encore monitor out of its carton, check to see that all the items listed on the packing slip (provided with shipment) are in the shipping carton.
4. If an item is missing, first recheck the carton, then check with your receiving department. If necessary, contact Protocol Systems at the address and phone number shown in **Technical Support Services** on page 16.

note...

**Save the shipping carton and packing material for repacking the Encore monitor in case it needs to be sent to a repair center or back to Protocol Systems for service.**

## Warranty Service

DO NOT ATTEMPT TO REPAIR the Encore monitor yourself during the warranty period. For fast, convenient service and repair, contact Protocol Systems. See **Technical Support Services** on page 16.

## Technical Support Services

Protocol Systems offers a wide range of technical support services including:

- 24-hour telephone support
- loaner equipment
- service contracts
- field replaceable units (FRUs)
- factory repair

For any of these services, contact Protocol Technical Support at the following numbers:

- toll free in the United States (800) 289-2501
- worldwide (503) 526-8500 and ask for Technical Support
- facsimile (503) 526-4910

For service outside the United States, contact one of the following service centers near you.

**United Kingdom and Continental Europe:**

Protocol Medical Systems Ltd., England
Derby Service Centre
St. Georges House, Vernon Gate
Derby, DE1 1UQ,
United Kingdom
Phone: 44 1332 206208
Fax: 44 1332 206209

**Continental Europe:**

Protocol Systems, GmbH., Germany
Berliner Strasse 106
D-66424 Homburg, Germany
Phone: 49 89 462 34 30
Fax: 49 89 460 70 87

**Worldwide Internet Access**

World Wide Web (WWW) URL: http://www.protocol.com/service
World Wide E-mail: solutions@protocol.com

## Recommended Service Intervals

At the intervals listed below, check the Encore monitor for normal operation.

| Interval/Condition | Perform | Located in this manual |
|---|---|---|
| Every 6 months to 2 years (according to hospital protocols). | Complete risk (leakage) current Safety Check followed by a Functional Verification. | Section 2 |
| If battery does not retain a charge. | Check battery pack capacity. | Section 4 |
| Monitor is dropped or suspected of damage or rough handling. | Complete Safety Check followed by Functional Verification. | Section 2 |
| Suspected malfunction with all or part of monitoring parameters. | Functional Verification of suspected parameter(s). | Section 2 |
| Monitor does not pass Functional Verification. | Calibration of monitoring parameter circuits, or repair, followed by Safety Check and Functional Verification. | Section 3 and Section 2 |

**WARNING**

**If the monitor is opened for repair or calibration, a dielectric strength test must be completed to ensure the integrity of the patient isolation barrier. The dielectric strength test procedure is provided in Section 2.**

## Identifying Propaq Encore Configurations

The following table identifies Propaq Encore configurations and how they are indicated. The model-option number and serial number are located on the back of the housing. The monitor indicators are located under the handle on the back.

| Product (Housing) | Model Number | Option Number | Defining Parameters | Serial Number Prefix |
|---|---|---|---|---|
| PROPAQ ENCORE MONITOR | 202-EL | | ECG, NIBP, 2 TEMP., RESP., EL DISPLAY | DA/EA |
| | 204-EL | | ECG, NIBP, 2 TEMP., 1 IBP, RESP., EL DISPLAY | |
| | 206-EL | | ECG, NIBP, 2 TEMP., 2 IBP, RESP., EL DISPLAY | |
| $SPO_2$-ONLY MODULE | | 210 | $SPO_2$ | DB/EB |
| EXPANSION MODULE | | 221 | PRINTER | DC/EC |
| | | 223 | PRINTER $SPO_2$ | |
| | | 224 | $SPO_2$, $MCO_2$ | |
| | | 225 | PRINTER, $SPO_2$, $MCO_2$ | |
| | | 226 | $SPO_2$, $SCO_2$ | |
| | | 227 | PRINTER, $SPO_2$, $SCO_2$ | |
| | | 228 | $SPO_2$, $MCO_2$, $SCO_2$ | |
| | | 229 | PRINTER, $SPO_2$, $MCO_2$, $SCO_2$ | |

## Self Test and Service Menus

The Encore monitor includes built-in self-tests that verify the integrity of its hardware and software each time you turn it on. If the monitor turns on and displays the Main Menu, all self-tests were passed. If a self-test results in a failure, a message and error code are displayed indicating the failure mode. Refer to Section 4 and contact Protocol Systems Technical Support for help.

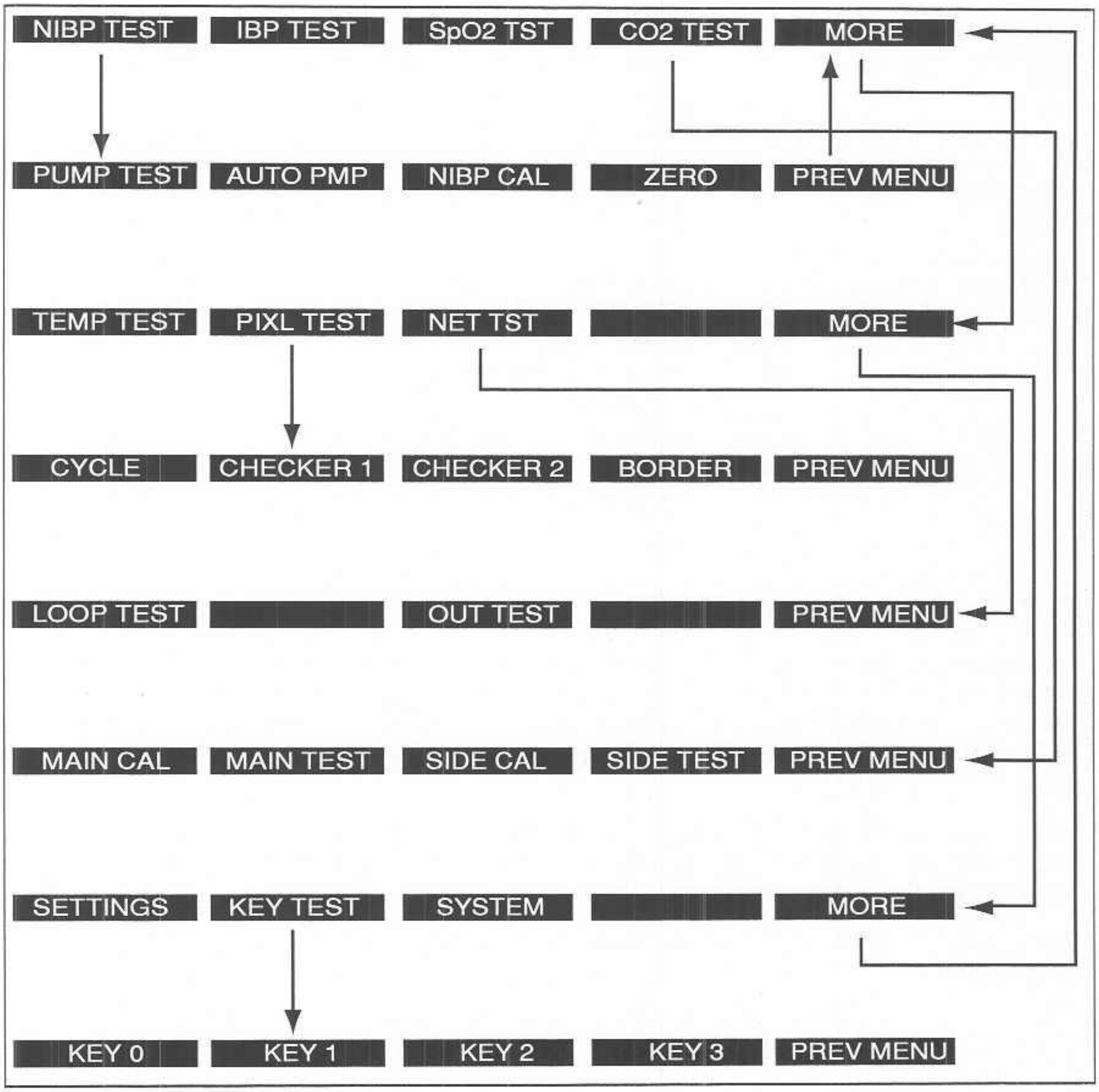
The Encore monitor contains software routines that make the Functional Verification and Calibration procedures quicker and easier. You access these routines through the Service Menus as indicated in each of the procedures.

The figure on page 20 shows the hierarchy of the Service Menus once you enter the top level Service Menu.

The procedures in this manual indicate which buttons to push by separating each button menu name with the (>) character. For example, to access the Service Menu, the procedures would indicate for you to press SETUP > MORE > MORE > SERVICE > YES, which means you press the SETUP button, then the MORE button, then the MORE button, then the SERVICE button, and finally the YES button.

note...

**The figure illustrates all Service Menu functions. Some of these functions are not available if you do not have the appropriate option.**


NIBP TEST
IBP TEST
SpO2 TST
CO2 TEST
MORE
PUMP TEST
AUTO PMP
NIBP CAL
ZERO
PREV MENU
TEMP TEST
PIXL TEST
NET TST
MORE
CYCLE
CHECKER 1
CHECKER 2
BORDER
PREV MENU
LOOP TEST
OUT TEST
PREV MENU
MAIN CAL
MAIN TEST
SIDE CAL
SIDE TEST
PREV MENU
SETTINGS
KEY TEST
SYSTEM
MORE
KEY 0
KEY 1
KEY 2
KEY 3
PREV MENU

# Section 2
# Functional Verification

## Introduction

The functional verification procedures ensure proper operation of the Encore monitor and its options. These procedures should be performed following module-level repairs, calibration, or whenever there is a question about the accuracy or safety of the patient functions.

The calibration procedures in Section 3 should be used to return the monitor to operation within its performance specifications. If the monitor does not pass the functional verification, or when it is time to do a routine calibration, see Section 3.

**WARNING**

**Whenever the monitor is opened for calibration or repair, a risk (leakage) current safety check as well as a dielectric strength integrity (hi-pot) test must be performed as described in this section.**

The Encore's service menu facilitates the functional verification. It has several features for testing and verifying the NIBP (cuff) channel, display, invasive pressure channel, and printer. Refer to Section 1 for information about the Service Menu.

### Self Tests

Many functions, such as alarms, waveform and scale sizing, and printer control, are software operations. During the monitor's power-up self-test, the integrity of all programming is checked first. If software testing is successful, hardware tests are initiated. If all testing is successful, the monitor is ready for use. (See Section 4 for information on error messages.)

## Required Equipment

You will need the following equipment to verify that all functions of the Encore operate correctly. All test equipment must be calibrated to function within parameters specified by the manufacturer, and must be traceable to a national calibration standard.

Some equipment can be manufactured. See Appendix A for information on manufacturable test equipment.

### Required Equipment

| Description |
|---|
| Luer connector, male, for use with 1/8" I.D. tubing (Value Plastics, MTLL230-1) |
| Luer connector, female, for use with 1/8" I.D. tubing (Value Plastics, FTLL230-1) |
| Test water trap, Protocol, 008-0370-00 |
| 1/8" inside diameter tubing |
| Flow meter, Cole Parmer E 32000-06, 200ml/min. or equivalent |
| 0 to 300 mmHg Mercury-column manometer, or calibrated pressure meter, with inflation squeeze bulb |
| 50 MHz triggered sweep oscilloscope |
| Variable dc power supply, 0-28 V, 3A with voltage and current metering |
| Patient simulator, Dynatech/Nevada 213A, 214A, 215A, or 217A with IBP, Temperature, and EGG Cable/Leads |
| Adult cuff (provided with monitor); Neonatal cuff #3; 3 cm diameter solid cylinder; solid cylindrical object about the size of an adult's arm |
| Protocol cuff calibration kit, Protocol PN 008-0012-XX |
| Power supply adapter cable, Protocol PN 008-0290-00 |
| Physio Control LifePak 5 or LifePak 6s with appropriate Protocol Systems Defib Sync adapter to use as Defib Sync Marker pulse source |
| Propaq ac power adapter (provided with the Encore) |
| Safety analyzer, Dynatech/Nevada, 431F-1D or equivalent |
| Rod-L Model M100AVS5 high-voltage potential (hi-pot) tester, or equivalent |
| Static-free work area |
| NELLCOR pocket tester, PT-2500 |
| Test gas source: dry 4% to 10% $CO_2$, balance air (with flow meter). Gas may be between 4% and 10%, but exact $CO_2$ concentration must be certified to ±0.01. (Convert percentage to partial pressure (mmHg) as instructed in Section 2.) |
| Two rubber test tube stoppers, with 1/8" to 1/4" holes drilled through (for $CO_2$ tests) |

# Safety Tests

The following two safety tests, a risk (leakage) current safety check and a dielectric strength integrity (hi-pot) test, must be performed whenever the Encore has been opened for calibration or repair.

*note...*

**A hi-pot test is only required if the monitor has been opened.**

## Risk (Leakage) Current Test

A risk (leakage) current test must be performed to verify that the patient remains electrically isolated from the power circuits of the Encore.

Check leakage currents using a Dynatech/Nevada 431F-1D safety analyzer or its equivalent. The source current should not exceed 10μA rms. The sink current, measured between the isolated patient connections (ECG) and the dc power input connector of the monitor, should not exceed 20μA rms. See the analyzer's operator's manual for the proper safety check procedure.

*note...*

**Because of the all-insulated construction of the monitor, an Enclosure Leakage Current Test to ground is not necessary.**

**Electrical Connections for Patient Risk (Leakage) Current Safety Tests**

| Safety Test | Power Adapter | Monitor dc Input | Monitor Cable | Safety Analyzer |
|---|---|---|---|---|
| Source current | Plugged into analyzer outlet | Connected to power adapter | RA | RA |
| | | | LA | LA |
| | | | LL | LL |
| | | | C | C |
| | | | RL | RL |
| Sink current | Not used | Connected to ground connector on analyzer | RA | RA |
| | | | LA | LA |
| | | | LL | LL |
| | | | C | C |
| | | | RL | RL |

## Dielectric Strength (Hi-Pot) Test

Because of the close spacings of the monitor's internal components and the critical positioning of the insulation sheet within the monitor, Protocol Systems, Inc. recommends that a dielectric strength test be performed following any procedure in which the monitor is opened.

**WARNING**

**The Hi-Pot test is extremely hazardous. Only qualified service personnel should perform this test. Conduct the test only on an insulated table top, away from other people and equipment.**

Use a Rod-L Model M100AVS5 high-voltage potential tester, or equivalent. Refer to the Rod-L instruction manual for operating information and safety recommendations.

1. Set the high voltage potential of the tester as specified in the table below.

**Summary of Connection Points and High-Voltage Test Potentials**

| Tester's high-voltage terminal connection | Tester's grounded return connection | High-voltage test parameters |
|---|---|---|
| All ECG leads on patient cable connected together | DC input connector; all pins connected together | Output: 4000 V ac rms<br>Current Limit: 2.5mA<br>Ramp-up: 8 seconds<br>Dwell: 1 second |

2. Connect the high-voltage output lead of the tester to all ECG leads, using a dedicated patient cable reserved for use only in such tests.
3. Connect the tester's chassis-connected return lead to the monitor's dc input connector, using a suitable plug.
4. Apply the test voltage for one second. The tester must not indicate dielectric breakdown.

**WARNING**

**If any dielectric breakdown occurs, do not use the monitor. All internal sheet insulation barriers must be properly installed. Check the monitor to determine the cause of dielectric breakdown; then repair the monitor or return the monitor to Protocol Systems for repair.**

# Functional Verification

The functional verification must be done only when the monitor is fully assembled. If the monitor has been stored for longer than one month without the monitor connected to the ac adapter (for recharging), the battery voltage must be checked. The battery must be replaced if it cannot hold a charge. Refer to Section 4 for a battery capacity test.

note...

**Some configurations of the Encore monitor do not include impedance pneumography (RESP) and other neonatal monitoring parameters. In these versions, RESP does not appear in menus or on the screen displays. You can ignore RESP and other terms relating to neonatal monitoring when indicated in the following instructions.**

**If you plan to use a Dynatech/Nevada model 213A, 215A, or 217A Patient Simulator to simultaneously simulate ECG and invasive blood pressure, see Appendix B for important information.**

**Before starting the verification procedures, charge the battery for at least 8 hours with the monitor turned off. (Charge for 12 hours if a Printer or $SpO_2$ module is attached.)**

## Power System

The following steps check the integrity of the Encore's power system.

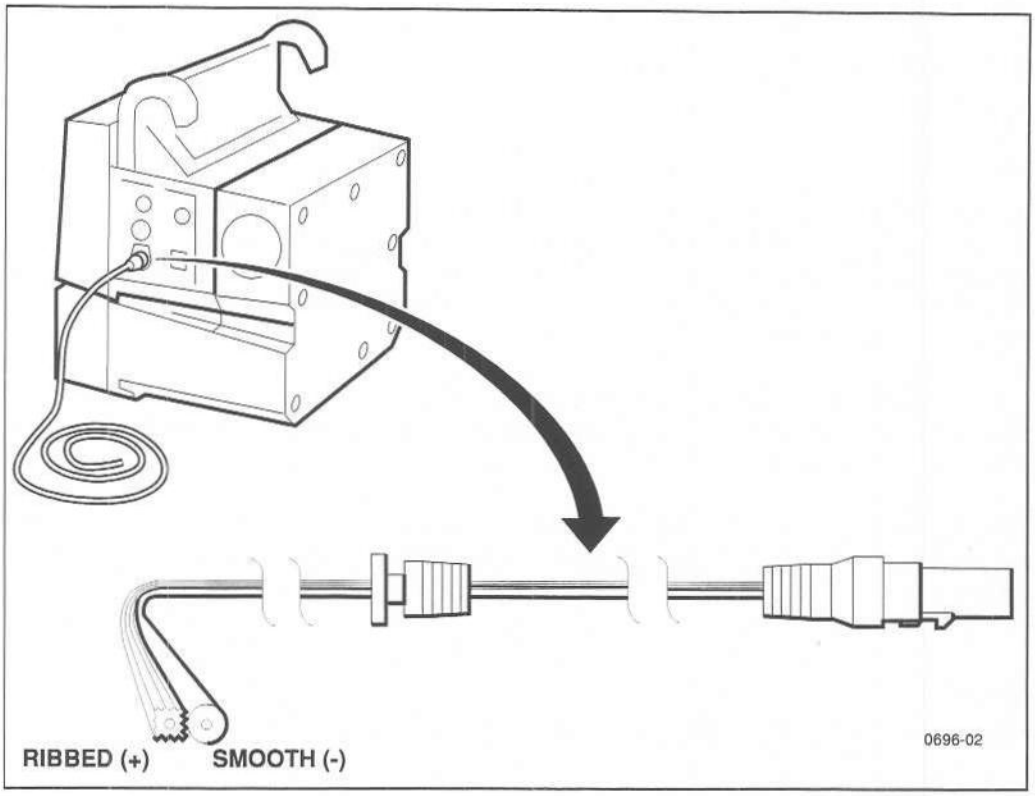
1. Turn the ac power adapter's power switch off.
2. Plug the ac power adapter into an ac mains receptacle and connect it to the Encore's right side panel dc power connector.
3. Check that the green LED charging indicator on the monitor's right side panel is off.
4. Turn on the power adapter's power switch.
5. Check that the green LED on the power adapter turns on and that the green LED charging indicator on the monitor's right side panel turns on.
6. Disconnect the power adapter from the monitor. Check that the monitor's green LED charging indicator on the right side panel turns off.

**CAUTION**

**In the next steps, carefully check for the proper polarity of the connection between the power supply and the monitor. If voltage is applied with the wrong polarity, it will open the right side panel fuse (F1). Refer to the figure on page 26 to verify proper polarity.**

7. Set the dc power supply meter to Volts and turn the power switch on; set it for 15.0V ± 0.1V.
8. Turn off the dc power supply.

9. Using the Protocol dc power supply adapter cable, refer to the figure below for polarity and connect the dc power supply to the monitor's dc input connector on the right side panel.



10. Turn on the dc power supply.

11. Check that the green LED indicator lights up.

note...

**Initial charge current for a low battery is higher than for a charged battery. As the battery charges, the current will decrease. The current draw may slowly drop the longer the dc supply is connected to the monitor.**

12. Switch the dc power supply meter to current and check that the current draw from the supply is less than 1.8 A.

13. Vary the power supply from 12 V to 28 V and verify that the charging LED stays on.

14. Turn off the power supply.

15. Disconnect the supply from the monitor.

## System Tests

The following procedures check that the buttons operate properly, that the display works correctly, and that the date is correctly displayed.

1. Turn on the monitor.
2. Verify that no error messages appear and the monitor correctly powers up.
3. Press SETUP > MORE > MORE > SERVICE > YES > MORE > PIXL TST to test the display.
4. Press CYCLE three times, each time verifying that no pixels are missing.
5. Press MAIN MENU twice.
6. Press SETUP > WAVE SEL > INSERV to access the inservice features. This generates simulated waveforms.
7. Press MAIN MENU.
8. Press the following buttons in sequence and verify that the monitor responds as indicated and the buttons do not stick.

| Press | Result |
|---|---|
| FREEZE/UNFREEZE | Freezes the waveforms |
| FREEZE/UNFREEZE | Unfreezes the waveforms |
| SETUP | Changes the menu |
| ALARMS | Changes the display |
| SUSPEND (on menu) | SUSPEND changes to RESUME |
| ALARM SUSPEND/RESUME (button) | Changes RESUME to SUSPEND |
| ALL ALARM | Changes display |
| LIMITS | Changes display |
| NEXT | Moves cursor block |
| MAIN MENU | Returns to the main menu |
| NIBP START/STOP (button) | Starts the NIBP pump |
| NIBP START/STOP (button) | Stops the NIBP pump |

9. Press ECG/RESP > MORE. Then press CHANGE to select the four HR/PR TONE levels. Verify that the tone volume changes and goes off when turned OFF. Set the volume to LOW.
10. Press MAIN MENU.
11. Press SETUP > MORE > MORE (> TIME/DAY for monitor software less than version 2.0) and check that the displayed time and date are correct.

    If incorrect, press NEXT and UP or DOWN to select and change the time and date, and then set by pressing the ENTER button.
12. Turn off the monitor.

## ECG/RESP Channel & Alarm Indicators

The following procedures verify the ECG channel and the alarm indicator drivers.

1. Turn on the monitor and verify that it powers up correctly.
2. Connect the ECG channel to the patient simulator using all five ECG leads.
3. Set the patient simulator as follows:

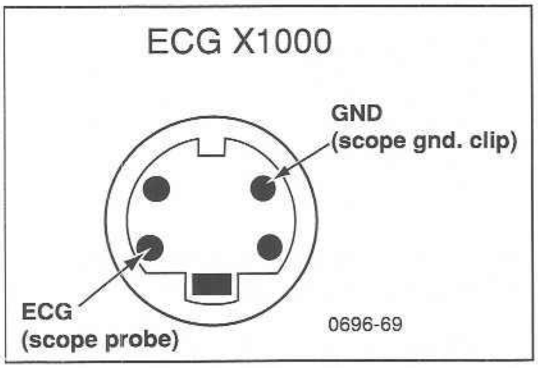
   ECG Waveform: normal sinus rhythm
   ECG Rate: 80 beats per minute (bpm)
   ECG Size: 1 mV amplitude
   Resp Lead: Lead I
   Resp Baseline Impedance: 1 KΩ
   Resp Rate: 40 breaths/minute (br/m)
   Resp Breath Amplitude: 1.0Ω

4. Set the monitor as follows:

   Respiration ON (ECG/RESP > MORE; select and set RESP to ON)
   ECG Lead: Lead II (ECG/RESP > ECG LEAD)
   Respiration Lead: Lead I (ECG/RESP > MORE then select the lead and change as necessary)
   ECG Size: 1 mV (ECG/RESP > ECG SIZE)
   Resp Size: 8X (ECG/RESP > RESP SZE)
   ECG Sweep: 25 mm/Sec (SETUP > MORE; select and change HR/PR sweep as necessary)
   Alarms: All alarms OFF (SETUP > ALARMS > ALL ALARM (>YES to confirmation screen for software version 2.0 and greater) until all alarms are off except for the Apnea alarm, which cannot be turned off

5. Press the FREEZE/UNFREEZE button to freeze the waveform.
6. Check that a normal sinus rhythm ECG waveform is displayed with a peak-to-peak amplitude of 10 ±1 mm. There should be a soft beep tone with each QRS event.
7. Check that the displayed respiration peak-to-peak amplitude is 12.5 ±1 mm.
8. Press FREEZE/UNFREEZE to unfreeze the display.
9. Check that the monitor's heart rate display is 80 ± 4 bpm.
10. Disconnect the LA ECG lead wire from the simulator.
11. Check that an equipment alarm occurs. The LEAD FAIL message should accurately indicate the removed lead.
12. Press any button to acknowledge.
13. Disconnect the LL ECG lead from the simulator.
14. Check that an equipment alarm occurs and a MULTIPLE LEAD FAIL message is displayed.
15. Press any button to acknowledge.
16. Reconnect all leads.
17. Check that the ALARM(S) OFF light is on.
18. Press SETUP > ALARMS > STAT SET to automatically set heart rate alarm limits.
19. Check that the ALARM(S) OFF light is off.

20. Set the patient simulator heart rate to 180 bpm or higher.
21. Check that an alarm violation occurs causing the tone to sound and the ALARM light to turn on.
22. Press the ALARM SUSPEND/RESUME button and verify that the tone turns off.
23. Press MAIN MENU.
24. Set the patient simulator heart rate to 80 bpm.
25. Set the patient simulator to provide pacer signals.
26. If the pacer indicator is not on, press ECG/RESP > MORE and select and change the pacer setting.
27. Check that a dashed vertical line is displayed on the ECG waveform each time a pacer pulse occurs.
28. Set the oscilloscope to 0.2 second/division sweep and 0.5 Volt/division amplitude.
29. Insert a short piece of thin conductive wire into each of the ECG X1000 connector holes shown in the figure below.

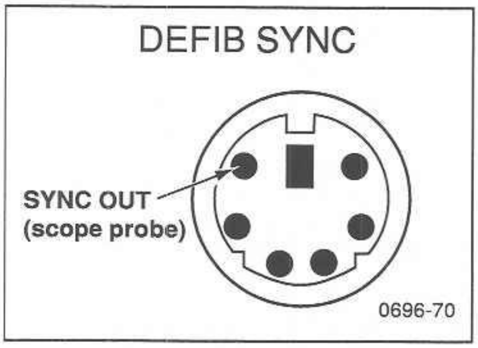


30. Connect the scope probe and the scope ground clip to the wires.
31. Check that the scope displays an ECG signal with an amplitude of 1 V ±100 mV baseline to peak of R-wave.

*note...*

**Some amount of mains noise may also be present in the signal.**

32. Move the wire and scope probe from the ECG pin of the ECG X1000 connector to the DEFIB SYNC connector pin shown in the figure below. Leave the scope's ground clip where it is.



33. Change the vertical sensitivity of the scope to 1 Volt/division.
34. Check that the scope displays a 5 V p-p pulse with a 100 ±5 ms width.
35. Disconnect the scope probe and ground clip and remove the wires from the connectors.
36. Using either a LifePak 5 or LifePak 6s and appropriate Protocol adapter, set up the monitor and defibrillator according to instructions provided in the *Defib Sync User's Guide.*
37. Check the monitor display for sync markers on the ECG waveform.
38. Disconnect the defibrillator from the monitor.

note...

**If the patient simulator does not also provide an appropriate ECG signal, the heart rate value will be displayed as – – – and an alarm violation will occur.**

39. Disconnect the ECG cable from the monitor. (Disconnecting an active channel initiates an equipment alarm; press any key to acknowledge the discontinuance of ECG monitoring.)

## IBP

The following procedure verifies the operation of the invasive blood pressure channels. Some models of the Propaq Encore have no IBP channels; skip this procedure if your Encore does not support IBP. If your Encore has multiple IBP channels, repeat the verification procedure for each channel.

CAUTION

**Many blood pressure simulators are not intended to be used as calibration standards. Use only the blood pressure simulators specified in the Required Equipment table on page 22.**

*note...*

**If you are using the Dynatech/Nevada model 213A, 215A, or 217A patient simulator, do not simultaneously monitor ECG and invasive blood pressure (IBP) unless the modification to the simulator is performed as described in Appendix B. If you do not wish to modify your simulator, use ECG and IBP independently.**

1. Press SETUP > WAVESEL and check that the P1 and P2 waveforms are turned on.
2. Connect the IBP cable from the patient simulator to an IBP input jack on the left side panel of the Encore.
3. Set the simulator output pressure to 0 mmHg.

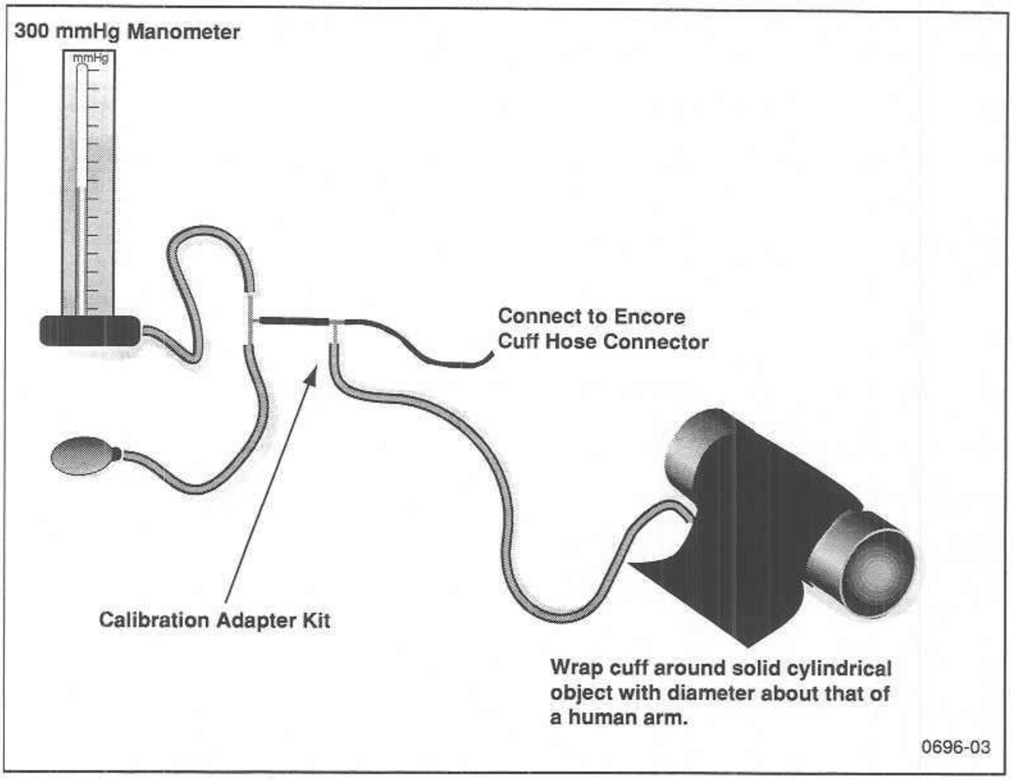
*note...*

**If an alarm tone sounds, press the SUSPEND/RESUME button.**

4. Zero P1 by pressing ZERO P1.
5. Check that ZEROED is displayed.
6. Press RESCALE.
7. Check for a noise level of ≤3 mm.
8. noise on the IBP waveform.
9. After allowing a few seconds for settling, check that the mean pressure reading is 0 mmHg ±1 mmHg.
10. Set the pressure simulator to 200 mmHg.
11. After allowing a few seconds for settling, check that the mean pressure reading is 200 mmHg ±2 mmHg.
12. Remove the cable from the P1 input jack and verify that the message: P1 FAULT - TRANSDUCER NOT DETECTED appears.
13. Press any button to acknowledge the discontinuance of IBP monitoring.
14. Press MAIN MENU.

## NIBP

1. Connect the adult cuff, manometer (or pressure meter) with bulb, and the monitor together with the Cuff Calibration Kit as shown in the figure below.

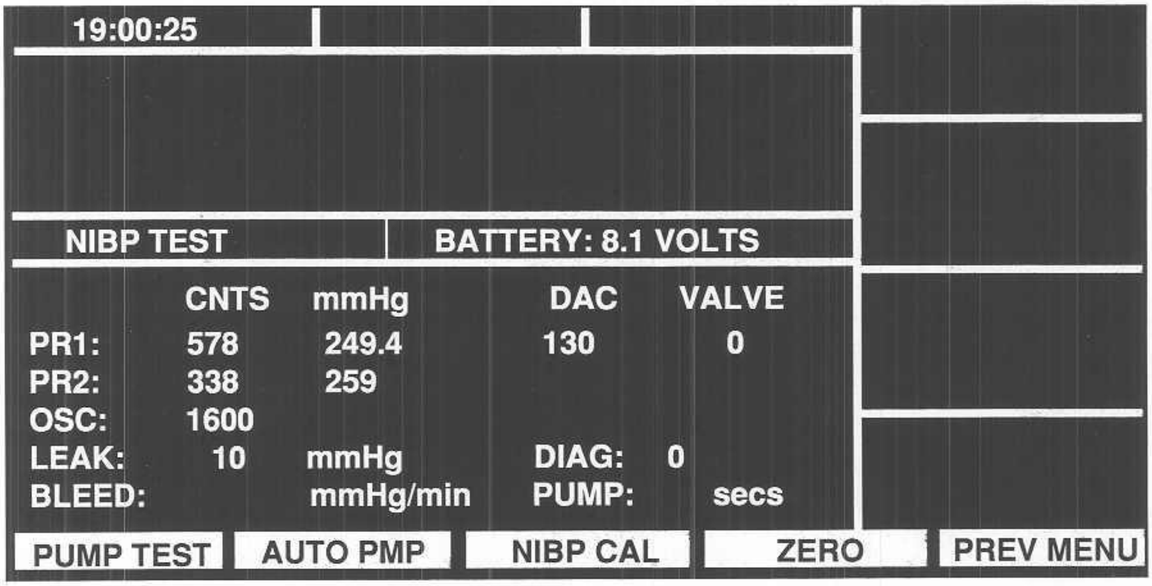

300 mmHg Manometer
mmHg
Connect to Encore
Cuff Hose Connector
Calibration Adapter Kit
Wrap cuff around solid cylindrical object with diameter about that of a human arm.
0696-03

2. Wrap the adult cuff around a cylindrical object about the size of an adult's arm.
3. Press SETUP > MORE > MORE > SERVICE > YES > NIBP TEST > NIBP CAL.

note...

**The NIBP CAL mode holds pressure for 10 minutes. If performing steps 4 through 9 takes longer than 10 minutes, press NIBP CAL again.**

4. Close the valve on the bulb and inflate the cuff to 250 mmHg as shown on the manometer.
5. Check that the readings (PR1 and PR2) on the monitor's display are 250 ±3 mmHg (PR1) and 250 ±15 mmHg (PR2), as show in the figure on page 33.



```
19:00:25

NIBP TEST                 BATTERY: 8.1 VOLTS

         CNTS    mmHg          DAC     VALVE
PR1:     578     249.4         130       0
PR2:     338     259
OSC:     1600
LEAK:      10    mmHg          DIAG:   0
BLEED:           mmHg/min      PUMP:       secs
```

6. Manually reduce the pressure as indicated on the manometer to each of the levels shown in the following table, and check the displayed value of PR1 to be within the tolerance listed in the following table.

| Pressure (mmHg) | Tolerance (mmHg) |
|---|---|
| 270 | ±4 |
| 250 | ±3 |
| 200 | ±2 |
| 100 | ±2 |
| 50 | ±2 |
| 20 | ±2 |

7. Reduce the pressure to 0 mmHg and check that the displayed readings (PR1 and PR2) are 0 ±2 mmHg.
8. Close the bulb valve.
9. Press CANCEL. (If there is no CANCEL button at this time, go to the next step.)
10. Disconnect the adult cuff from the test setup and connect the neonatal cuff #3 that is wrapped around a solid 3 cm diameter cylinder.
11. Press PUMP TEST.
12. Check that the pump inflates the cuff to approximately 280 mmHg.
13. After four minutes, check that the displayed leakage is less than 50 mmHg.

note...

**If the leakage exceeds this specification, first check all exterior hoses and fittings before diagnosing an internal air leak problem.**

14. Press MAIN MENU.
15. Disconnect the cuff and Cuff Calibration Kit.

## Temperature

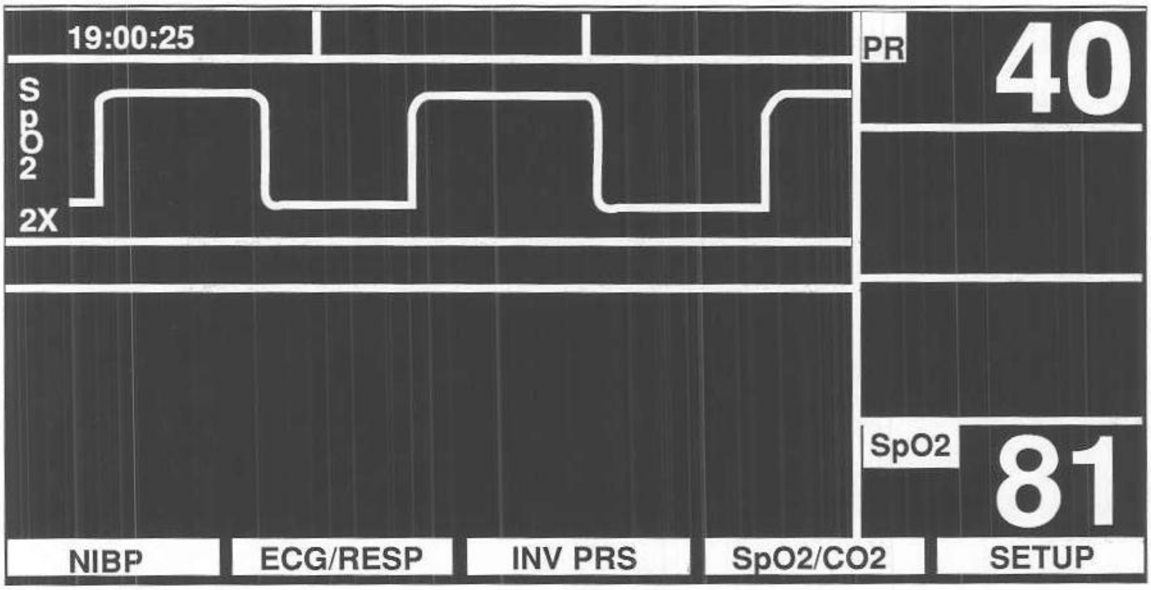
1. Plug a 37.0° C YSI 400 series (two conductor) calibrated temperature probe simulator into the T1 jack on the Encore's left side panel.
2. Check that the T1 temperature is 37° ± 0.1° C.
3. Repeat Steps 1 and 2 for T2.
4. Plug a 37° C YSI 700 series (three conductor) temperature probe simulator into the T1 jack.
5. Check for 37° ± 0.1° C.
6. Repeat Steps 4 and 5 for T2.
7. Remove all connectors and turn the Encore off.

## $SpO_2$ Checks

The following steps check the operation of the pulse oximetry option ($SpO_2$).

1. Disconnect all test cables from the patient channel connectors. (It is not necessary to disconnect the cuff hose.)
2. Connect a NELLCOR $SpO_2$ tester to the monitor.

   The NELLCOR $SpO_2$ tester has no on/off switch: it automatically turns on with the monitor power.
3. Turn off all alarms by pressing the ALARMS SUSPEND/RESUME button.
4. Check that the displayed $SpO_2$ numeric is 81 ±2.
5. Check that the pulse rate is 40 ±3.
6. Check that the waveform is similar to the one shown on page 35.



7. Check that the speaker is sounding with every pulse indicated on the display.
8. Disconnect the $SpO_2$ tester from the Encore.
9. Check that an equipment alarm occurs.
10. Press any button to acknowledge the discontinuance of $SpO_2$ monitoring.
11. Press MAIN MENU.

### Printer Tests

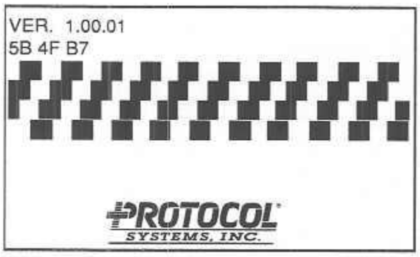
The following steps check the functionality of the printer.

*note...*

**Functional verification should be performed on the monitor before beginning the printer tests. The monitor must be functioning properly in order to perform printer tests.**

1. Disconnect all cables from the monitor.
2. Turn the monitor OFF then ON.
3. Press SETUP > WAVE SEL > INSERV.
4. Press MAIN MENU.
5. Wait at least 8 seconds and then press the printer's SNAPSHOT button.
6. Check that the printer prints an approximately eight-inch strip of the simulated patient data. The paper should stop only after the entire waveform has been fed out of the printer.
7. Press the printer's START/STOP button. The printer should begin continuous printing.
8. Press the START/STOP button to stop printing.

9. Lay the Propaq Encore on its back.
10. Press the START / STOP button to start printing.
11. Completely open the paper door on the bottom of the Expansion Module.
12. Check that the printer stops printing, and that an equipment alarm and CHECK DOOR message appear on the monitor screen.
13. Cut or tear the printer paper in the printer mechanism from the roll, leaving the strip of paper in the printer mechanism.
14. Completely close the paper door.
15. Press the START / STOP button.
16. After the printer runs out of paper, check that an equipment alarm and PAPER OUT message appear on the monitor screen.
17. Open the printer door and reload the paper into the printer.
18. Close the paper door and set the monitor upright.
19. Simultaneously press the PRINT TRENDS and START / STOP buttons.
20. Check that a test printout similar to one shown in the figure below is printed.



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PROTOCOL
SYSTEMS, INC.

## $CO_2$ Verification Preparation

The mainstream and sidestream $CO_2$ functional verification procedures require calculating the local barometric pressure and partial pressure of the test gas (in mmHg) to compare to Propaq Encore displayed values.

**Local barometric pressure**

The first step is to determine the local barometric pressure:

1. Determine local altitude above sea level.

   For worldwide locations, obtain altitude from local geological maps (U.S.G.S. maps in the United States) or other local references on the maps. Refer to the table titled: Uncorrected Barometric Pressure as as Function of Altitude; use this table to determine the local uncorrected pressure (LUP).

2. Determine ATIS reported pressure (inches or millimeters of Hg).

   For U.S. locations, consult local telephone directories to obtain the Automated Terminal Information Service (ATIS) number, typically listed under United States Government Offices, Department of Transportation, Federal Aviation Administration, and Air Traffic Control Towers.

Among various statistics reported is the "altimeter," which is given in four integers. The four digits represent the barometric pressure as referred to sea level, in units of inches of mercury, with an assumed decimal point occurring between the second and third numbers.

For worldwide locations, equivalent altimeter statistics, in millimeters of mercury, may be obtained from local agencies.

note...

**The difference in altitude between the calibration site and the ATIS site should not be greater than 30 m or 100 ft.**

3. Determine local barometric pressure using LUP and ATIS. Apply the ATIS and LUP values to the following formula to calculate the local barometric pressure (mmHg):

Local Barometric Pressure =
0.033421 x LUP x ATIS (ATIS in inches of Hg)
0.00131579 x LUP x ATIS (ATIS in mm of Hg)

**Example 1**

Step 1. The altitude is 5000 *feet*. The local uncorrected pressure (LUP) is determined from the following table to be 632.35.

Step 2. The reported ATIS is 30.09 inches Hg. (Altimeter: three zero zero niner.)

Step 3. Multiply the LUP (632.35) times the ATIS (30.09) times 0.033421.

This gives the local barometric pressure of 635.92 mmHg.

**Example 2**

Step 1. The altitude is 1000 *meters*. The local uncorrected pressure (LUP) is determined from the following table to be 674.11.

Step 2. The reported ATIS is 764.29 mmHg.

Step 3. Multiply the LUP (674.11) times the ATIS (764.29) times 0.00131579.

This gives the local barometric pressure of 677.92 mmHg.

**Partial pressure of test gas source**

To determine the partial pressure of test gas source multiply the local barometric pressure (as determined in step 3 above) by the certified percentage (±0.01% accuracy) of the test gas.

**Example**

The local barometric pressure (as calculated in Example 1 above) is 635.92 mmHg.

The certified $CO_2$ gas percentage is 5.00%.

Determine the $CO_2$ partial pressure by multiplying (635.92) x (0.0500).

This gives the partial pressure of the $CO_2$ as 31.8 mmHg.

### Local Uncorrected Barometric Pressure (LUP) as a Function of Altitude (Feet)

| Altitude (Feet) | Pressure (mmHg) | Altitude (Feet) | Pressure (mmHg) | Altitude (Feet) | Pressure (mmHg) | Altitude (Feet) | Pressure (mmHg) |
|---|---|---|---|---|---|---|---|
| -2000 | 816.56 | 1000 | 732.93 | 4000 | 656.38 | 10000 | 522.65 |
| -1900 | 813.66 | 1100 | 730.27 | 4200 | 651.52 | 10333 | 515.93 |
| -1800 | 810.76 | 1200 | 727.62 | 4400 | 646.68 | 10667 | 509.26 |
| -1700 | 807.87 | 1300 | 724.97 | 4600 | 641.88 | 11000 | 502.69 |
| -1600 | 804.99 | 1400 | 722.33 | 4800 | 637.10 | 11333 | 496.18 |
| -1500 | 802.11 | 1500 | 719.70 | 5000 | 632.35 | 11667 | 489.72 |
| -1400 | 799.25 | 1600 | 717.07 | 5200 | 627.64 | 12000 | 483.34 |
| -1300 | 796.39 | 1700 | 714.46 | 5400 | 622.95 | 12333 | 477.04 |
| -1200 | 793.54 | 1800 | 711.85 | 5600 | 618.28 | 12667 | 470.78 |
| -1100 | 790.70 | 1900 | 709.25 | 5800 | 613.65 | 13000 | 464.60 |
| -1000 | 787.87 | 2000 | 706.65 | 6000 | 609.04 | 13333 | 458.50 |
| -900 | 785.05 | 2100 | 704.07 | 6200 | 604.47 | 13667 | 452.44 |
| -800 | 782.23 | 2200 | 701.49 | 6400 | 599.92 | 14000 | 446.46 |
| -700 | 779.42 | 2300 | 698.92 | 6600 | 595.40 | 14333 | 440.55 |
| -600 | 776.62 | 2400 | 696.36 | 6800 | 590.90 | 14667 | 434.68 |
| -500 | 773.83 | 2500 | 693.80 | 7000 | 586.44 | 15000 | 428.89 |
| -400 | 771.05 | 2600 | 691.26 | 7200 | 582.00 | 15333 | 423.17 |
| -300 | 768.28 | 2700 | 688.72 | 7400 | 577.58 | 15667 | 417.49 |
| -200 | 765.51 | 2800 | 686.18 | 7600 | 573.20 | 16000 | 411.89 |
| -100 | 762.75 | 2900 | 683.66 | 7800 | 568.84 | 16333 | 406.35 |
| 0 | 760.00 | 3000 | 681.14 | 8000 | 564.51 | 16667 | 400.86 |
| 100 | 757.26 | 3100 | 678.63 | 8200 | 560.21 | 17000 | 395.44 |
| 200 | 754.52 | 3200 | 676.13 | 8400 | 555.93 | 17333 | 390.08 |
| 300 | 751.80 | 3300 | 673.64 | 8600 | 551.68 | 17667 | 384.76 |
| 400 | 749.08 | 3400 | 671.15 | 8800 | 547.45 | 18000 | 379.52 |
| 500 | 746.37 | 3500 | 668.67 | 9000 | 543.26 | 18333 | 374.34 |
| 600 | 743.67 | 3600 | 666.20 | 9200 | 539.08 | 18667 | 369.20 |
| 700 | 740.97 | 3700 | 663.73 | 9400 | 534.94 | 19000 | 364.13 |
| 800 | 738.28 | 3800 | 661.27 | 9600 | 530.82 | 19333 | 359.12 |
| 900 | 735.61 | 3900 | 658.82 | 9800 | 526.72 | 19667 | 354.15 |

## Local Uncorrected Barometric Pressure (LUP) as a Function of Altitude (Feet)

| Altitude (Feet) | Pressure (mmHg) | Altitude (Feet) | Pressure (mmHg) | Altitude (Feet) | Pressure (mmHg) | Altitude (Feet) | Pressure (mmHg) |
|---|---|---|---|---|---|---|---|
| 1000 | 732.93 | 4000 | 656.38 | 10000 | 522.65 | 20000 | 349.24 |

## Local Uncorrected Barometric Pressure (LUP) as a Function of Altitude (Meters)

| Altitude (Meters) | Pressure (mmHg) | Altitude (Meters) | Pressure (mmHg) | Altitude (Meters) | Pressure (mmHg) | Altitude (Meters) | Pressure (mmHg) |
|---|---|---|---|---|---|---|---|
| -700 | 825.23 | 1000 | 674.11 | 2700 | 546.23 | 4400 | 438.74 |
| -650 | 820.43 | 1050 | 670.03 | 2750 | 542.79 | 4450 | 435.86 |
| -600 | 815.65 | 1100 | 665.98 | 2800 | 539.37 | 4500 | 432.99 |
| -550 | 810.89 | 1150 | 661.94 | 2850 | 535.96 | 4550 | 430.14 |
| -500 | 806.15 | 1200 | 657.92 | 2900 | 532.58 | 4600 | 427.31 |
| -450 | 801.43 | 1250 | 653.92 | 2950 | 529.21 | 4650 | 424.49 |
| -400 | 796.74 | 1300 | 649.94 | 3000 | 525.85 | 4700 | 421.69 |
| -350 | 792.07 | 1350 | 645.98 | 3050 | 522.52 | 4750 | 418.90 |
| -300 | 787.43 | 1400 | 642.04 | 3100 | 519.20 | 4800 | 416.12 |
| -250 | 782.80 | 1450 | 638.12 | 3150 | 515.90 | 4850 | 413.36 |
| -200 | 778.20 | 1500 | 634.22 | 3200 | 512.62 | 4900 | 410.62 |
| -150 | 773.61 | 1550 | 630.34 | 3250 | 509.35 | 4950 | 407.89 |
| -100 | 769.05 | 1600 | 626.48 | 3300 | 506.10 | 5000 | 405.18 |
| -50 | 764.52 | 1650 | 622.63 | 3350 | 502.87 | 5050 | 402.48 |
| 0 | 760.00 | 1700 | 618.81 | 3400 | 499.65 | 5100 | 399.79 |
| 50 | 755.51 | 1750 | 615.00 | 3450 | 496.45 | 5150 | 397.12 |
| 100 | 751.03 | 1800 | 611.22 | 3500 | 493.27 | 5200 | 394.46 |
| 150 | 746.58 | 1850 | 607.45 | 3550 | 490.10 | 5250 | 391.82 |
| 200 | 742.15 | 1900 | 603.70 | 3600 | 486.95 | 5300 | 389.19 |
| 250 | 737.74 | 1950 | 599.97 | 3650 | 483.82 | 5350 | 386.58 |
| 300 | 733.35 | 2000 | 596.26 | 3700 | 480.70 | 5400 | 383.98 |
| 350 | 728.99 | 2050 | 592.57 | 3750 | 477.60 | 5450 | 381.39 |
| 400 | 724.64 | 2100 | 588.89 | 3800 | 474.51 | 5500 | 378.82 |
| 450 | 720.32 | 2150 | 585.24 | 3850 | 471.44 | 5550 | 376.27 |
| 500 | 716.01 | 2200 | 581.60 | 3900 | 468.39 | 5600 | 373.72 |
| 550 | 711.73 | 2250 | 577.98 | 3950 | 465.36 | 5650 | 371.20 |

**Local Uncorrected Barometric Pressure (LUP) as a Function of Altitude (Meters)**

| Altitude (Meters) | Pressure (mmHg) | Altitude (Meters) | Pressure (mmHg) | Altitude (Meters) | Pressure (mmHg) | Altitude (Meters) | Pressure (mmHg) |
|---|---|---|---|---|---|---|---|
| 600 | 707.47 | 2300 | 574.38 | 4000 | 462.33 | 5700 | 368.68 |
| 650 | 703.23 | 2350 | 570.80 | 4050 | 459.33 | 5750 | 366.18 |
| 700 | 699.01 | 2400 | 567.24 | 4100 | 456.34 | 5800 | 363.69 |
| 750 | 694.81 | 2450 | 563.69 | 4150 | 453.37 | 5850 | 361.22 |
| 800 | 690.63 | 2500 | 560.16 | 4200 | 450.41 | 5900 | 358.76 |
| 850 | 686.47 | 2550 | 556.65 | 4250 | 447.47 | 5950 | 356.31 |
| 900 | 682.33 | 2600 | 553.16 | 4300 | 444.54 | 6000 | 353.88 |
| 950 | 678.21 | 2650 | 549.68 | 4350 | 441.63 | 6050 | 351.46 |
| 1000 | 674.11 | 2700 | 546.23 | 4400 | 438.74 | 6100 | 349.05 |

## Mainstream $CO_2$ Verification Procedure

This procedure verifies the accuracy of the Encore's mainstream $CO_2$ ($MCO_2$) measuring system. If verification test results exceed specification limits, calibration as instructed in Section 3 MAY or MAY NOT be required—there are multiple possible sources of errors in testing as listed in the table on page 42.

1. Connect a $MCO_2$ sensor with airway adapter to the Encore $MCO_2$ input connector.
2. Turn on the Encore. Press ALARM SUSPEND / RESUME to disable the alarms.
3. Press SETUP > MORE > MORE (>SERVICE > YES > MORE > MORE > SETTINGS, for software versions 2.0 and greater) and then set the $CO_2$ measurement units to millimeters of mercury (mmHg).
4. Allow the monitor and sensor to warm up for at least 15 minutes.

*note...*

**Possible errors may be caused if the area has high background $CO_2$ levels or if $CO_2$ has been forced outside of the airway adapter and into the sensor itself. To reduce the background $CO_2$ level, the area should be well ventilated and, preferably, the technician should be the only person present. If $CO_2$ has been forced into the sensor, allow 24 to 48 hours for the $CO_2$ to dissipate.**

5. After 15 minutes, check that the $CO_2$ reading (of ambient room air) on the Encore display is 1 mmHg, ±1 mmHg.
6. Install a rubber stopper in each end of the sensor airway adapter. (Refer to the Required Equipment list on on page 22.)
7. Connect the $CO_2$ gas source through the hole in the stopper on one end of the airway adapter. Leave the other end open.

*note...*

**Before performing the following steps, convert the percentage of the gas source to partial pressure (mmHg) according to the procedures in Mainstream $CO_2$ Verification Preparation on page 36.**

8. Introduce a flow of test $CO_2$ at a rate of 60 to 200 ml / min into the sensor airway adapter.
9. For test gas calculated partial pressure values of 30 mmHg or less, check the $CO_2$ reading on the Encore display to be within 3 mmHg.
10. For test gas calculated partial pressure values greater than 30 mmHg, check the $CO_2$ reading on the Encore display to be within ±10% of the partial pressure value.

*note...*

**If $CO_2$ test results are out of specification limits, check the table on page 42 for possible error sources. Always verify the test setup to minimize errors.**

11. Disconnect the test gas source and other test equipment.
12. Disconnect the $CO_2$ sensor from the monitor.

13. Turn off the monitor.

14. Log the test date and results in your department log.

**WARNING**

**Eliminate all the possibilities causing errors shown in the following table before performing the calibration procedure in Section 3. Recalibrating the altimeter as described in Section 3 without adequately eliminating all other possible faults may result in inaccurate $EtCO_2$ readings.**

**Possible Sources of $CO_2$ Verification Test Errors**

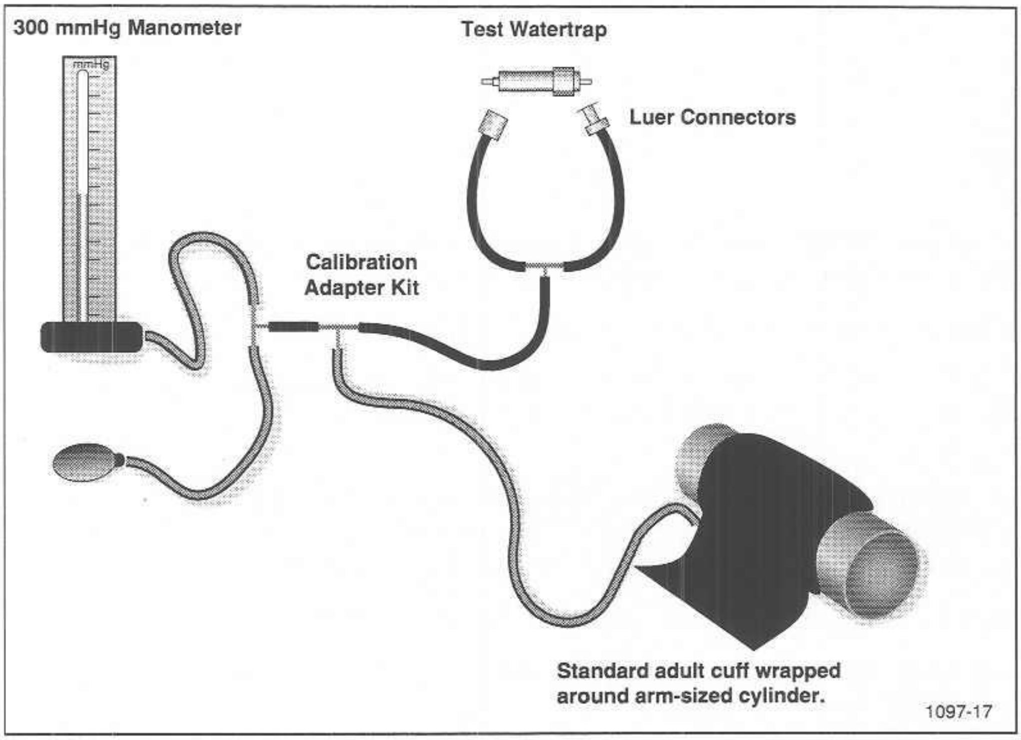
| Error | Specification | Correction |
|---|---|---|
| Incorrect/unknown calibration gas concentration | 4 to 10% certified to within ±0.01% | Verify gas supply. Gas must be between 4% and 10%. Once known, convert percentage to partial pressure (mmHg) as instructed earlier in this section. |
| Insufficient/excessive gas flow rate | Between 60 and 200 ml/min | Verify with flow meter. |
| Excessive back pressure in cuvette | Back pressure should not exceed 1 mmHg | Connect gases as instructed in verification test. |
| Air mixed with standard gas | | Check integrity of test setup. |
| Gas temperature | Gas temperature entering airway adapter should be at room temperature | Store gas at room temperature. |
| Cuvette error | Results should not vary more than 0.5 mmHg due to cuvette tolerances | Use another cuvette (airway adapter). |
| Thermal equilibrium error | Sensor not warmed up | Allow sensor/system to operate for a 15 minute warm-up period. |
| High $CO_2$ reading with sensor subject to room air only | $CO_2$ forced outside of airway adapter into sensor. This is possible during demonstration if exhaled gases are blown through hands cupped around cuvette and exhaled gases are forced into sensor. | Contain exhaled breath through the inside of cuvette only. Do not allow gases to be forced outside of cuvette and into sensor housing. If $CO_2$ has been forced into sensor allow 24 to 48 hours for the $CO_2$ to dissipate. |

## Sidestream $CO_2$ Verification Procedure

The following procedures verify the operation of the sidestream $CO_2$ ($SCO_2$) option.

1. Allow the monitor to warm-up for 3 minutes before performing the $SCO_2$ tests.
2. If present, disconnect the mainstream sensor from the monitor.

3. If installed, remove the water tap from the receiver on the front left panel of the expansion module
4. Determine the local barometric pressure as instructed in the $CO_2$ Verification Preparation section on on page 36, steps 1-3.
5. Select the SIDE TST screen through SETUP > MORE > MORE > SERVICE > YES > $CO_2$ TEST
6. Verify that BARO TRUE and INT are within 15mmHg (5mmHg, typical) of the barometric pressure determined in step 4.
7. Connect the test tubing setup shown in the figure below to both ends of a test water trap.



8. Use the pump bulb to manually inflate the pressure to 100mmHg as read on the pressure meter or manometer.
9. Wait 15 seconds for the pressure to stabilize. Note the pressure reading, then wait an additional 60 seconds and check that the pressure has not dropped more than 10mmHg. (Replace the water trap and retest if the leak rate is over 10mmHg.) Record the leak rate value for use in step 17 below.
10. Disconnect the water trap from the test setup and install it into the water trap receiver of the monitor under test. Wait for SRCH to appear in the $SCO_2$ numerics window.
11. Plug the water trap inlet and verify that the monitor generates an OCCLUSION-CHECK WATER TRAP/TUBING equipment alert message. Acknowledge the equipment alert. Wait for SRCH to appear in the $SCO_2$ numerics window.
12. Plug the exhaust port and verify that the monitor generates an OCCLUSION-CHECK EXHAUST PORT/TUBING equipment alert message. Acknowledge the equipment alert.

**CAUTION**

**The occlusion test can stress any defective pneumatic tubing connections and may cause leakage. Always perform the following leak test after the occlusion test to reveal any tubing problems.**

13. Through the $CO_2$/$SPO_2$ > $CO_2$ >MORE menu, push SOURCE to turn off CO2/BR monitoring. Confirm the message.
14. Connect the test tubing setup as shown on page 43 to the water trap inlet and to the exhaust port.

**CAUTION**

**Do not exceed 100mmHg during the following pressurization. Excessive pressure can open internal tubing connections and cause leakage.**

15. Use the pump bulb to manually inflate the pressure to 100mmHg.
16. Wait 15 seconds for the pressure to stabilize. Note the pressure reading, then wait an additional 60 seconds and record the leak rate. This is the total leakage (including water trap leakage from step 9).
17. Subtract the water trap leakage (determined in step 9) from the total leakage (determined in step 16) to obtain the internal $SCO_2$ leak rate which should be less than 10mmHg. The total leakage, including water trap leakage from step 9, cannot be more than 10mmHg.
18. Disconnect the tubing setup from the water trap and exhaust port.
19. With water trap installed in the water trap receiver, turn on $SCO_2$ monitoring through $CO_2$/$SPO_2$ > $CO_2$ >MORE > SOURCE.
20. Through the $CO_2$/$SPO_2$ > $CO_2$ > MORE > FLOW RATE menus, set the monitor flow rate to 90mL/min.
21. Wait 5 minutes.
22. Connect the flow meter to the water trap.
23. Check that the measured flow rate is between 76 and 104 mL/min.
24. Disconnect the flow meter from the tubing connected to the water trap (leave the open length of tubing connected.)
25. Connect the flow meter in line with the $CO_2$ gas delivery tubing.
26. Adjust the $CO_2$ flow for a rate of 110-200mL/min.
27. Insert the gas delivery tubing and the open sampling line from step 24 into a small ziplock bag (sandwich sized) with the zip lock closed as far as possible without pinching the tubing. This will slightly pressurize the bag with the test gas.

28. Wait two minutes for the bag to fully equalize with the test gas.
29. Calculate the partial pressure of the test gas used as instructed in the $CO_2$ Verification Preparation section beginning on page 36.
30. Multiply the calculated partial pressure (in mmHg) from step 29 by 0.95316. Record this calculation for use in step 33.
31. Select the SIDE TST through the SERVICE > $CO_2$ TEST > SIDE TST menus.
32. Observe the instantaneous $CO_2$ value on the service screen for a constant value indicating that the $CO_2$ concentration in the ziplock bag has stabilized.
33. Check that the observed instantaneous $CO_2$ value is within 3mmHg or 10%, whichever is greater, of the calculated value from step 30 (round up all half values on the service screen to the next higher mmHg).
34. Disconnect the test setup.

# Section 3
# Calibration

## Introduction

This section provides calibration procedures for the Propaq Encore. These procedures allow you to calibrate the Encore to Protocol factory specifications. Calibrations procedures should be performed only by qualified service personnel.

Calibration procedures must be performed whenever a question arises as to the performance of the Encore, and as indicated in Section 1.

Functional verification procedures (see Section 2) verify that the monitor is performing to its specifications. A functional verification (Section 2) must follow the calibration.

note...

**Respiration, temperature, printer, and $SpO_2$ options do not require calibration. Sidestream $CO_2$ has no user-performable calibration. After replacement of any modules to support service of these options, perform a functional verification for those associated modules.**

note...

**The mainstream $CO_2$ circuitry should be calibrated only if it fails the functional verification procedure of Section 2 AND you have eliminated all possible faults as listed in the table Possible Sources of $CO_2$ Verification Test Errors on page 42.**

## Equipment Needed

You will need the following equipment to calibrate the Propaq Encore monitor. Part numbers are given for equipment available from Protocol Systems, Inc.

*note...*

**All test equipment must be calibrated to function within parameters specified by the manufacturer, and be traceable to a national calibration standard.**

**Required Equipment**

| Description |
|---|
| Digital multimeter (DMM), 4 1/2 digit, Fluke 805A or equivalent |
| 50MHz triggered sweep oscilloscope, Tektronix 2225 or equivalent |
| Variable dc power supply, 0-28V, 3A, VIZ WP-715A or equivalent |
| Patient simulator, Dynatech/Nevada 213A, 214A, 215A, or 217A with temperature and EGG cable/leads |
| 0 to 300mmHg mercury-column manometer with bulb |
| Invasive blood pressure (IBP) simulator, 5μ/V/mmHg, Fogg Systems BP48C, BP28, or MDE Datasim 6000, with IBP cables |
| Adult cuff (provided with monitor); cylindrical object about the size of an adult's arm |
| Protocol cuff calibration kit, Protocol part number 008-0012-XX |
| Propaq Encore ac power adapter (provided with monitor) |
| Resistor test loads (4.9Ω and 4.65Ω). Refer to Appendix A. |
| Dc supply cable, Protocol part number 008-0290-XX |
| Tools necessary to disassemble and reassemble the Encore monitor. (See Section 5 for a list of necessary tools and instructions on opening the monitor.) |

# Procedures

This section contains procedures for calibrating the Propaq Encore monitor:

- Recharger board
- Analog board
- Digital board

CAUTION

**All calibration, service, and repair must be done at a static-protected work station. Failure to protect against damage due to static discharge can damage components in the Propaq Encore.**

## Setup

You must work at a static-protected work station. In order to calibrate the monitor you must open and then perform some disassembly to reach the necessary calibration points.

CAUTION

**Refer to Section 5 for all disassembly and re-assembly procedures. Failure to follow disassembly procedures may result in damaged internal parts.**

1. Before you begin disassembly, charge the battery pack for at least 8 hours to ensure it is fully charged.
2. Remove any options attached to the monitor. If either the $SpO_2$ or expansion module is attached to the monitor, remove it before starting the calibration. The calibration procedures in this section are for the three Encore monitor boards only.
3. Remove the battery pack.
4. Disconnect the ac power adapter from the monitor's right side panel power input connector.
5. Open the monitor.
6. Disconnect P1 (expansion connector cable) from the Analog board and open the front chassis approximately 90 degrees.

note...

**To disable the alarms while performing the calibration procedures, press SETUP > ALL ALRM ( >YES - version 2.0 software)to remove the bell symbol from the display. In order to inhibit the Apnea alarm, turn off Respiration monitoring: press ECG/RESP > MORE and set RESP to OFF.**

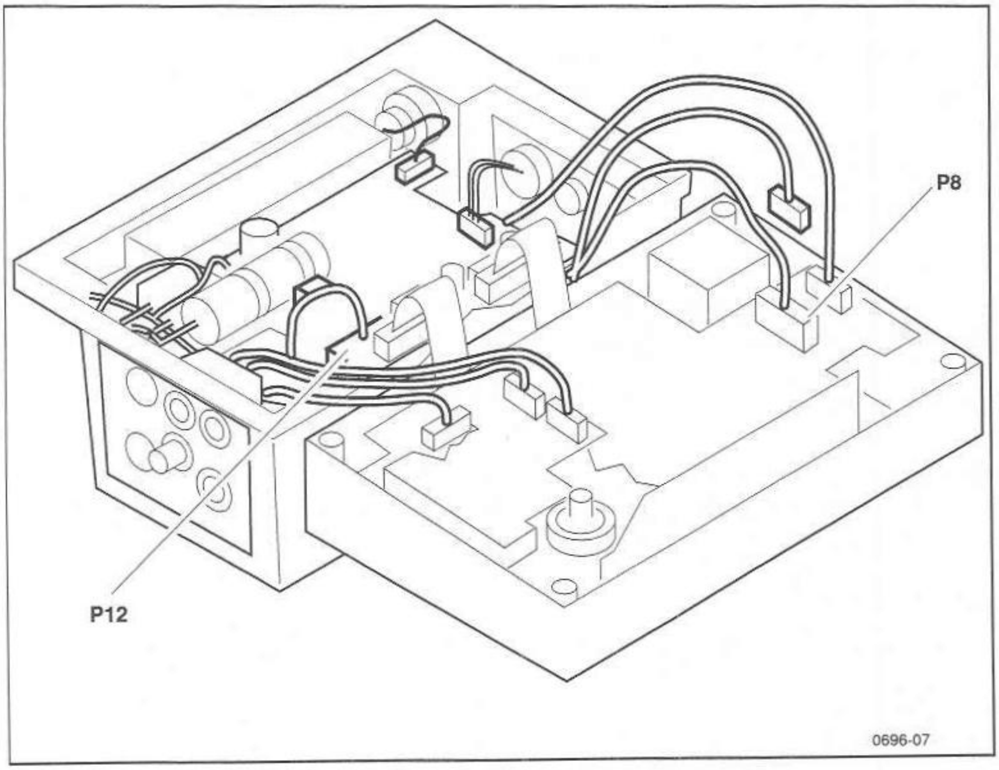
## Recharger Supply Adjustments

**WARNING**

**High voltages (approximately ± 200V dc or 360V ac) are present on the recharger board when the Encore is turned on. These voltages present a shock hazard if contacted during calibration.**

**Use non-conductive adjustment tools and keep fingers and conductive objects away from the Recharger board components when calibrating.**

1. Verify that the Encore power switch is off.
2. Disconnect the battery connector from P12 on the recharger board (see figure below).
3. Disconnect P8 from the Digital board (see figure below).

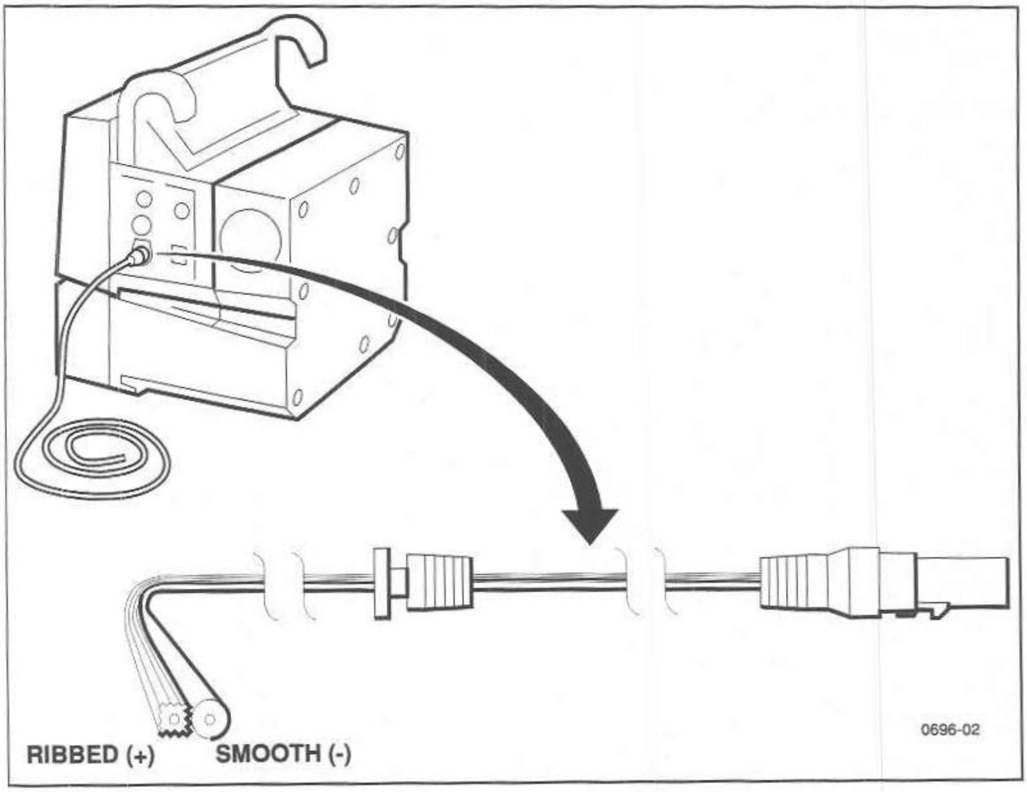


4. Connect the 4.9Ω test load (see Appendix A) to the battery connector (P12).
5. Set the power supply output to 15.0V dc.

CAUTION

**Adjustment of RP3 in step 12 on page 51 below sets an overvoltage limit which, if misadjusted, can cause fuse F1 (on the right side panel) to open. If you suspect that RP3 has been misadjusted, turn it fully clockwise before connecting power to the dc input jack on the Propaq Encore.**

6. Attach the dc power adapter cable to the variable dc power supply as shown figure below.



7. Connect the adapter cable to the monitor's dc input jack.
8. Verify that the input current from the variable dc power supply is less than 1.8A and that the green LED on the Encore's right side panel is on.

note...

**Refer to the figure on on page 53 for adjustment and test point locations.**

9. Connect the DMM positive lead to P12 pin 1 or 5.
10. Connect the DMM reference (negative) lead to non-isolated ground at TP2.
11. Adjust RP5 to 9.400V ± 0.010V dc.
12. Move the DMM positive lead to TP4.
13. Adjust RP3 to 2.393 V ± 0.015V dc.

14. Move the positive lead back to P12 pin 1 or 5.
15. Vary the input voltage from 12V to 28V and check that the output voltage remains constant. The battery load voltage must not vary more than 0.100V dc.
16. Decrease the power supply voltage from 12V to 7V while checking the right side panel green LED. The LED should turn off between 7 and 12V.
17. Disconnect the adapter cable from the Encore's right side panel.
18. Remove the 4.9Ω test load and replace it with the 4.65Ω test load.
19. Reconnect the adapter cable.
20. Adjust RP1 to 9.350V ± 0.010V dc.
21. Remove the 4.65Ω.
22. Reconnect the cable to P12.

# Display Voltage Adjustments

note...

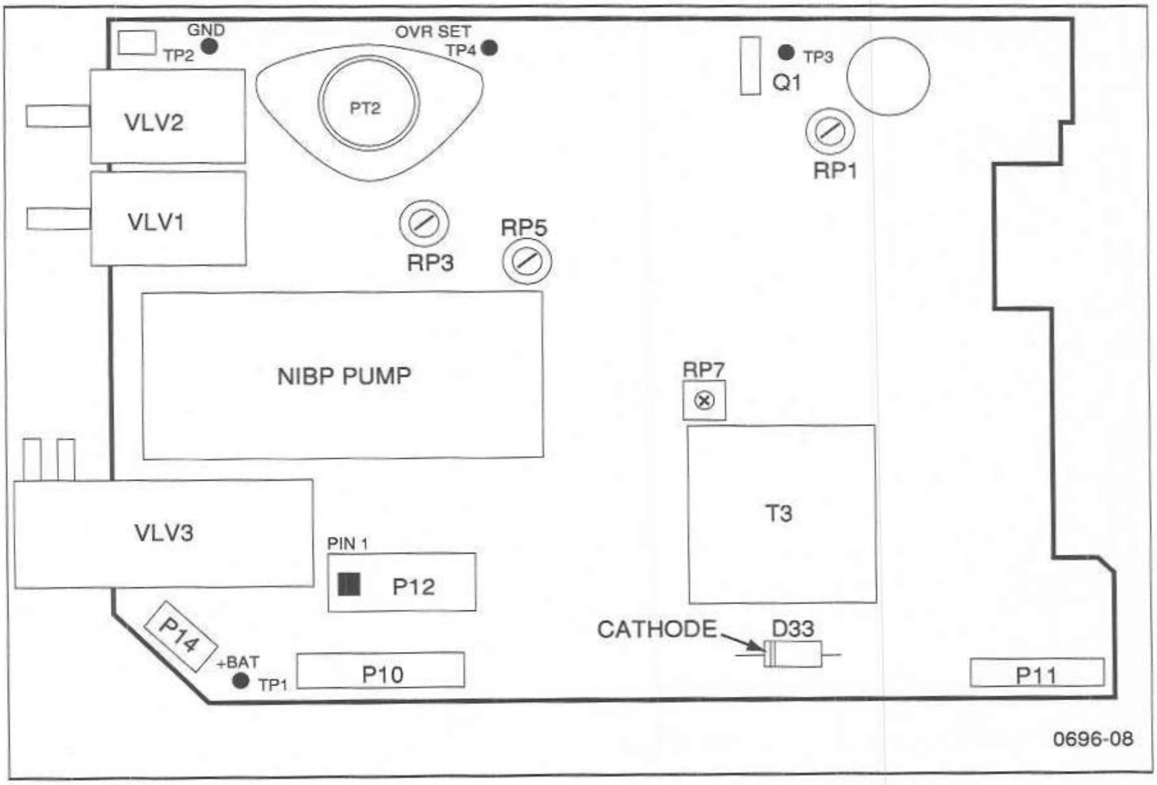
**Do not adjust the display voltage unless the display has been changed and the lack of contrast between illuminated and non-illuminated pixels affects the display readability.**

The following calibration adjusts the monitor display's high voltage supply which is located on the recharger board. The factory-set voltage is specific to the display and is indicated on the display module label.

If you know the voltage specified on the display label (i.e., are calibrating following an installation) use Procedure 1, below. If you do not know the voltage, use Procedure 2.

### Procedure 1

1. Install the display according to the procedures described in Section 5, reconnect the cables between the front and rear chassis, and turn on the Encore. Note that when you turn the power on and off you initiate an equipment alert. Press any one of the five bottom buttons to reset.
2. Connect the DMM positive lead to the D33 cathode.



3. Connect the DMM reference lead to ground at TP2.
4. Adjust RP7 to the value indicated on the display module label.

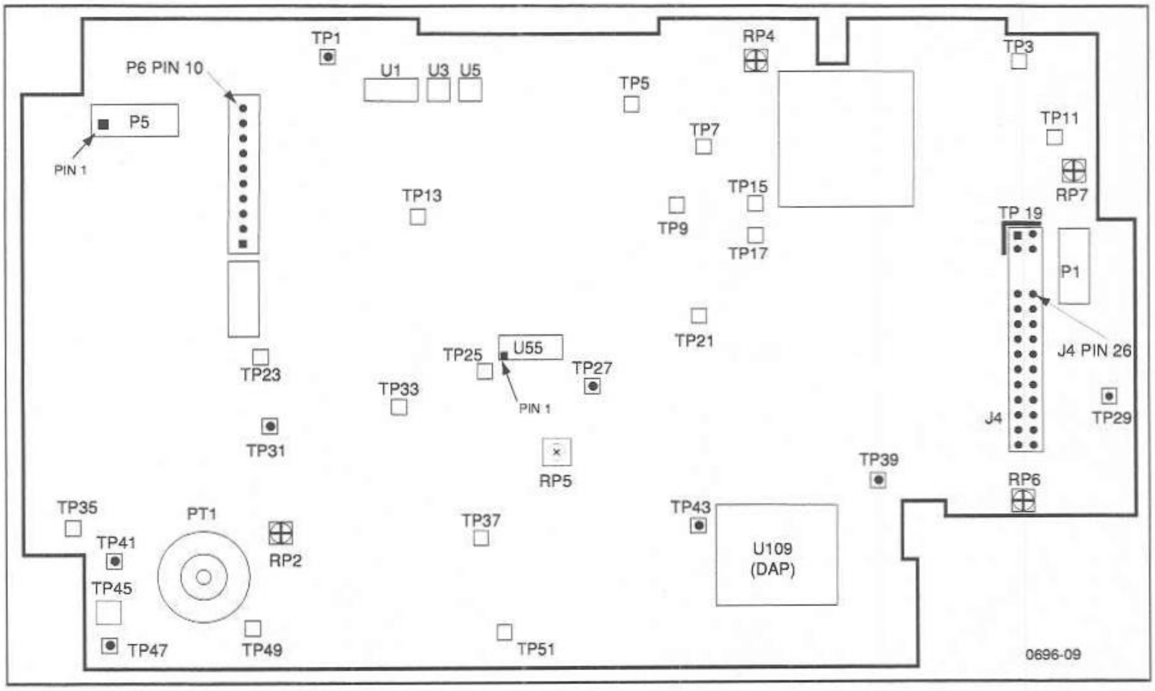
**Procedure 2**

1. Turn on the Encore and position the display for easy viewing.
2. Adjust RP7 clockwise until the background illuminates.
3. Find the brightest background area on the display and view this area through a paper tube approximately 2 inches in diameter (such as a paper towel or tissue paper tube) to shield the area from ambient light.
4. Adjust RP7 counter-clockwise until the viewed area fades to black.
5. Reposition the tube to view the brightest area (now dim) and simultaneously a lighted area (pixels on). Adjust RP7 clockwise until the background area just begins to illuminate.

## Main Power Supply Adjustments

The following procedures assume you are continuing from the recharger board calibration. If not, refer to the setup procedures provided at the beginning of this section.

1. Turn off the monitor.
2. Remove the metal shield from the analog board. (Note the two different screw sizes; refer to Section 5 for instructions, if necessary.)


TP1
P6 PIN 10
U1
U3
U5
TP5
RP4
TP3
P5
PIN 1
TP7
TP11
RP7
TP13
TP15
TP9
TP17
TP 19
P1
TP21
J4 PIN 26
TP25
U55
TP27
TP23
TP33
PIN 1
J4
TP29
TP31
RP5
TP39
RP6
TP35
PT1
TP43
TP37
TP41
RP2
U109
(DAP)
TP45
TP47
TP49
TP51
0696-09

3. Connect the DMM reference lead to TP39.
4. Connect the DMM positive lead to TP29.
5. Turn on the monitor.

   Press any of the lower five buttons to reset the Encore following equipment alerts.

6. Adjust RP7 to 5.000V ±0.010V dc.
7. Refer to the table below and check the dc supply voltages using the DMM.

**Main Power Supply Voltage Checks**

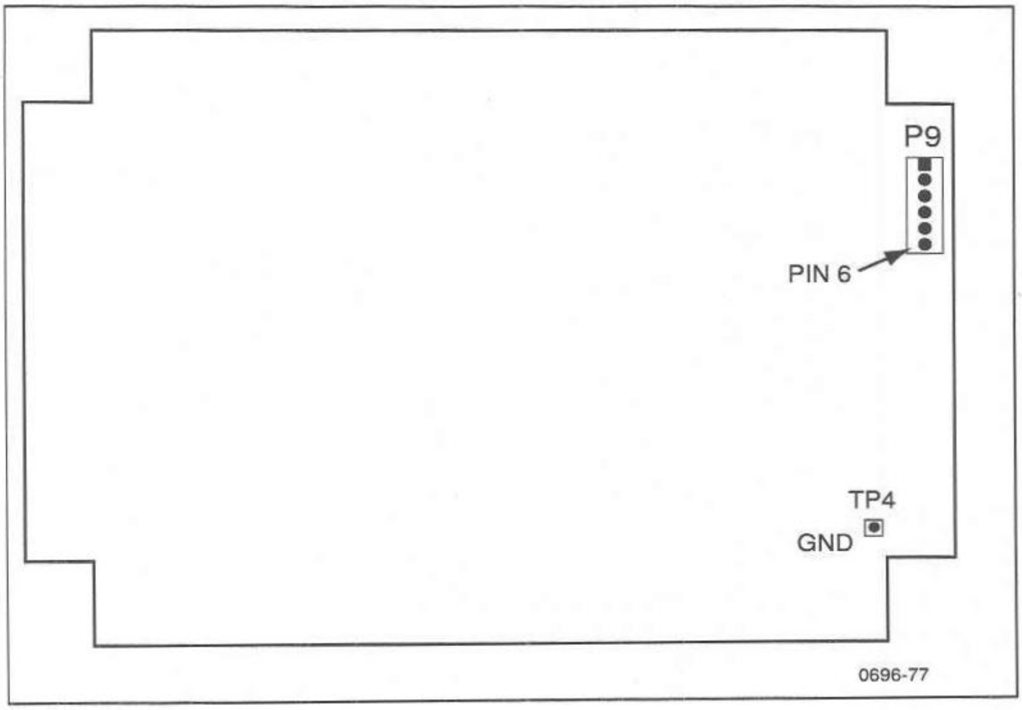
| Supply Voltages | Ref. Lead | Pos. Lead | Voltage Limits |
|---|---|---|---|
| Non-isolated | | | |
| +15 | TP39 | TP3 | +14.7 to +15.3 |
| –15 | TP39 | TP11 | –14.8 to -15.5 |
| Isolated | | | |
| +VR | TP43 or TP1 | TP9 | +4.91 to +5.09 |
| +VS | TP43 or TP1 | TP5 | +6.58 to +7.15 |
| –VS | TP43 or TP1 | TP21 | -6.65 to -7.15 |
| +VB | TP43 or TP1 | TP13 | +5.40 to +6.10 |
| +5.6 | TP43 or TP1 | TP33 | +5.55 to +5.70 |
| IBP shield | TP43 or TP1 | P6, Pin 10 | +2.47 to +2.53 |
| C.L.P. detector [a] | TP43 or TP1 | U5, Pin 1 | 0.00 to +0.25 |
| NIBP Pressure Offset | TP43 or TP1 | TP31 | +2.40 to +2.60 |
| OSC baseline | TP43 or TP1 | TP47 | -0.95 to -1.25 |
| +VA | TP43 or TP1 | TP7 | (+VR + 0.1V) to<br>(+VR + 0.2V) |
| -VA | TP43 or TP1 | TP15 | (+VR + 0.2V) to<br>-(VR + 0.35V) |
| +2.5 | TP43 or TP1 | TP17 | +2.48 to+2.52V |

[a] Make sure the ECG input connector (P5) is disconnected from the analog board for this measurement. Reconnect when done.

8. Disconnect the DMM leads.

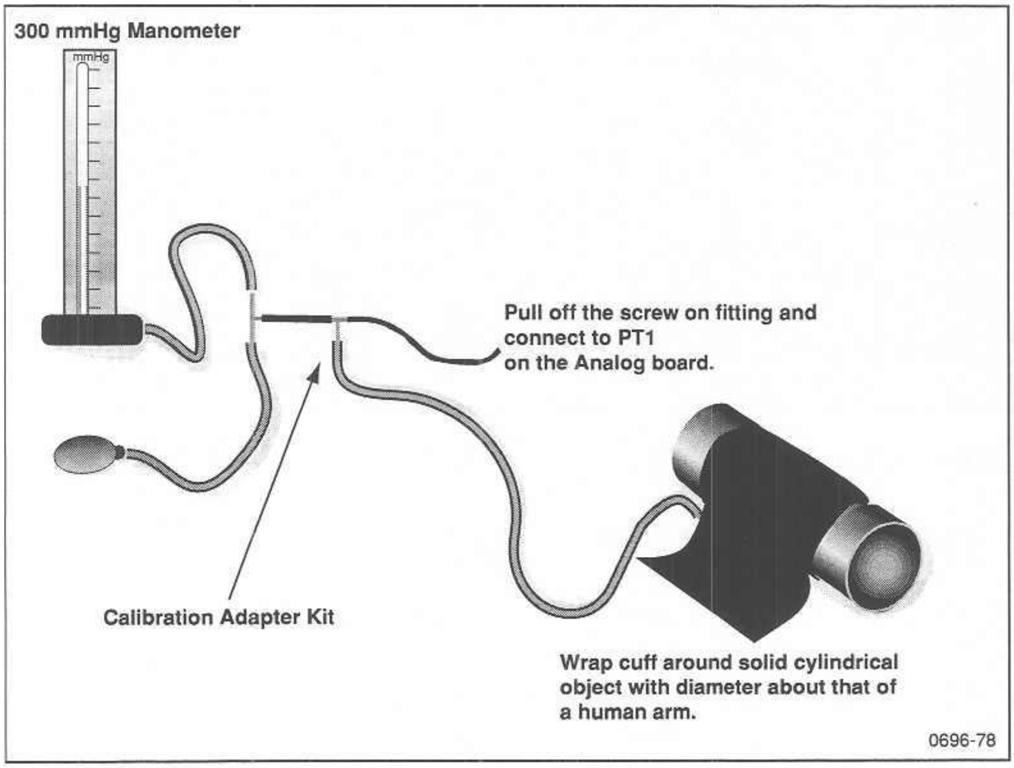
## Calibrating Realtime ECG Out

1. Connect the 5-lead ECG cable to the monitor and the simulator.
2. Set the simulator to 80 bpm, normal sinus rhythm.
3. Set the monitor to Lead II.
4. Connect the dc-coupled oscilloscope probe to the **Digital board** at P9 pin 6 (see figure below), and the reference probe to TP4 on the **Digital board**.
5. On the Analog board, carefully short together U55 pins 1 and 2.
6. Adjust RP6 on the Analog board to 0V dc ± 0.1V.
7. Remove the short and check for an ECG signal displayed on the oscilloscope of 1.0V± 0.1V baseline to peak of the R-wave.
8. Disconnect the ECG cable from the monitor.



## Non-Invasive Blood Pressure Calibration

1. Connect the cuff, manometer with bulb, and the Encore together with the cuff calibration kit, as shown.

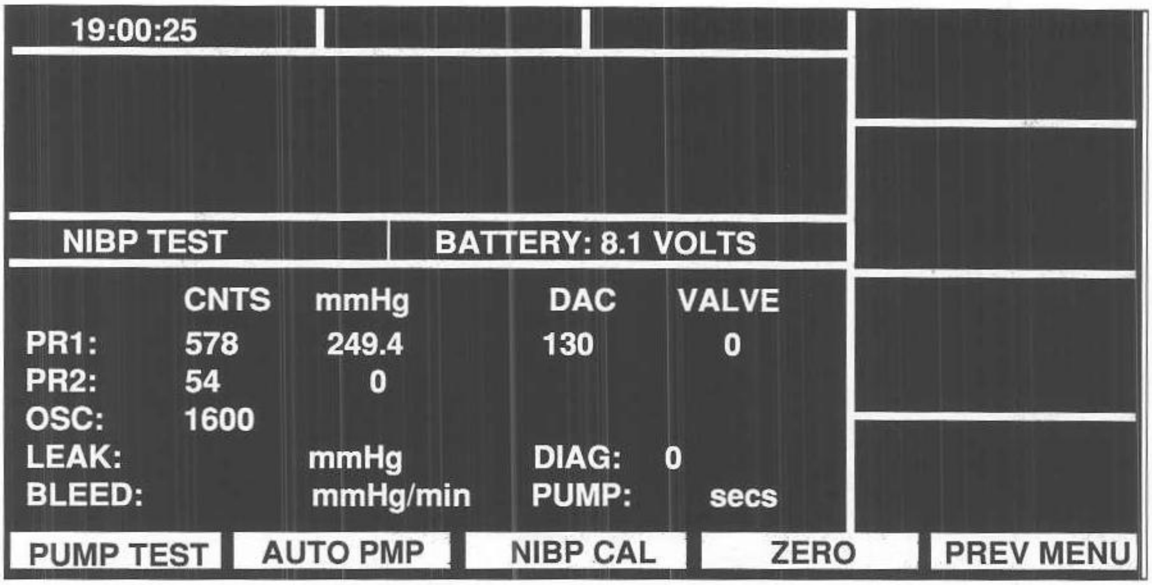

300 mmHg Manometer
mmHg
Pull off the screw on fitting and connect to PT1 on the Analog board.
Calibration Adapter Kit
Wrap cuff around solid cylindrical object with diameter about that of a human arm.
0696-78

2. Connect the NIBP test setup to the pressure transducer at PT1.
3. Wrap the adult cuff around a cylindrical object about the size of an adult's arm.
4. Press SETUP > MORE > MORE > SERVICE > YES > NIBP TEST > NIBP CAL. Use the bulb to inflate the system pressure to 250mmHg, as read on the manometer.

*note...*

**If testing takes more than 10 minutes, NIBP CAL will cancel. Press NIBP CAL again and resume testing.**

5. Watching the value of PR1 on the Encore monitor screen, adjust RP2 until the service screen reading matches the manometer.



```
19:00:25

NIBP TEST                BATTERY: 8.1 VOLTS

          CNTS    mmHg          DAC     VALVE
PR1:      578     249.4         130       0
PR2:      54        0
OSC:      1600
LEAK:             mmHg          DIAG:  0
BLEED:            mmHg/min      PUMP:      secs
```

6. Manually change the system pressure to check linearity tolerances at the following levels:

| Pressure (mmHg) | Tolerance (mmHg) |
|---|---|
| 270 | ±4 |
| 250 | ±3 |
| 200 | ±2 |
| 100 | ±2 |
| 50 | ±2 |
| 20 | ±2 |

7. Deflate the pressure to 0mmHg.
8. Disconnect the tube from the transducer.
9. Set the oscilloscope to ac-coupled, bandwidth limited.
10. Connect the oscilloscope probe to TP47 on the Analog board.
11. Connect the oscilloscope reference lead to TP43 or TP1 on the Analog board.
12. Check for ≤ 15mV peak-to-peak noise.

note...

**Measure the low frequency noise (bounce) only. Make the peak-to-peak measurement from the center-to-center of the trace to disregard the "fuzzy" high frequency noise.**

13. Disconnect all patient inputs to the Encore's left side panel.

## EMI Null Adjustment

1. Touch the oscilloscope probe to TP45 on the Analog board (square metal pad).
2. Disconnect the oscilloscope reference lead.
3. Set the oscilloscope vertical sensitivity and horizontal timing to observe the ac mains noise component.
4. Adjust RP4 to null the higher frequency (≈100kHz) noise over-riding the ac mains component.
5. Move the oscilloscope probe to TP19 (upside down "L" shaped pad above J4). See figure on on page 54.
6. Adjust RP1 on the Digital board (accessed through slot in Analog board) to null higher frequency (≈100kHz) noise, over-riding the ac mains component.
7. Disconnect the scope probe.

## Invasive Blood Pressure

Skip this part of the calibration procedure if your Encore does not support IBP measurements.

CAUTION

**Many blood pressure simulators are not intended for use as calibration standards. Use only recommended simulators for calibrating the Encore.**

1. Connect the IBP simulator to P1 on the Encore left side panel.
2. Set the patient simulator to 0mmHg.
3. Press ZERO P1 to zero the channel.
4. Set the patient simulator to 200mmHg.
5. Adjust RP5 for a numeric reading of 200mmHg on the Encore monitor screen.

note...

**If your Propaq Encore does not include a second pressure channel, skip Steps 6 - 10.**

6. Move the IBP cable to the P2 connector.
7. Set the simulator to 0mmHg.
8. Press ZERO P2 to zero the channel.
9. Set the simulator to 200mmHg.
10. Check that P2 displays 200mmHg ±2 mmHg.
11. Disconnect all patient cables from the left side panel.

12. Reinstall the Analog board shield and torque it according to the procedure in Section 5.

## MSP Board ($MCO_2$) Calibration

The Propaq MSP board has two calibration adjustments. One adjustment (RP2) is a null adjust for electromagnetic interference emissions—this adjustment has no effect on $MCO_2$ performance/accuracy. The other adjustment (RP1) is a barometric pressure/altimeter setting. This adjustment is set at Protocol during the production calibration process and does not require readjustment for use at other altitudes.

note...

**The verification section of this manual (Section 2) provides a procedure to verify $MCO_2$ accuracy. if the verification test results are within specifications, board calibration is not required. If verification test results exceed specification limits, RP1 calibration MAY or MAY NOT be required. Before adjusting RP1, check test parameters as indicated in the Table on page 42 to minimize testing errors. Determine local barometric pressure as described in Section 2 (on page 36) to verify Propaq barometer setting. Adjust RP1, if required, as instructed below.**

1. From Propaq main menu, push SETUP > MORE > MORE > SERVICE > YES > $CO_2$ TEST > MAIN TST and observe the displayed barometric pressure. Check that the displayed pressure is within 3mmHg of the local barometric pressure as calculated in Section 2.
2. Adjust RP1 on MSP board if required to calibrate displayed pressure to specified limits.
3. Using an oscilloscope with a 1X probe, connect probe tip to TP50 on the MSP board. Leave probe groundtip open.
4. Adjust RP2 for minimum high frequency (100kHz) signal.

WARNING

**You must perform a functional verification after calibrating the Propaq Encore to ensure all monitoring functions and safety features operate normally.**

note...

**Because the battery was disconnected in the calibration procedures, you will need to reset the time, date and all saved settings. See the *Propaq Encore User 's Guide* for information on resetting these parameters.**

# Section 4
# Troubleshooting

## Introduction

This section provides information that can be helpful in troubleshooting the Propaq Encore monitor.

## Screen Messages

Messages may appear on the display to inform the operator of some condition requiring operator or service attention. Messages that indicate that the Propaq Encore may need servicing are listed below. For information about other messages, refer to the *Propaq Encore Reference Guide*.

**PROGRAM FAULT: SETTINGS LOST, TIME/DAY RESET.** If this message appears when the Propaq Encore is first turned on, it generally indicates a drained battery. The monitor can be used, but the time and date and all other settings will return to factory defaults each time the monitor is turned off. Replace the battery as soon as possible and reprogram the time, date, and other settings according to the *Propaq Encore Reference Guide*.

**CUFF FAULT: NIBP DISABLED, SERVICE REQUIRED.** A single fault was encountered in the NIBP system. Perform a functional check and calibration or repair as needed.

**CALIBRATION ERROR, TEMP DISABLED.** This message appears when the Propaq Encore has detected that temperature circuitry is out of calibration. The temperature channel is disabled until the Propaq Encore is repaired. There are no temperature channel adjustments; the temperature channel uses a regulated power supply as a reference. Check all power supply values (Section 3). The Analog board may need to be replaced.

**SENSOR FAILURE - EEPROM - (MCO$_2$).** A failure in the sensor EEPROM is detected (typically a checksum error). The CO$_2$ channel is disabled until the sensor cable is disconnected. Replace the sensor.

**SENSOR FAILURE, HEATER - (MCO$_2$).** A failure in the sensor temperature control hardware is detected. This is typically a sensor error, but may be an MSP board fault. Replace the sensor or MSP board as required.

**SENSOR FAILURE, MOTOR DRIVE - (MCO$_2$).** The mainstream sensor motor drive hardware has failed. The channel is disabled until the sensor is disconnected. Replace the sensor.

**DEGRADED WAVEFORM, CHECK ADAPTER - (MCO$_2$).** The airway adapter (cuvette) may be contaminated or the light source in the sensor may be faulty. Clean or replace the cuvette as required or replace the CO$_2$ sensor.

**LACK OF WAVEFORM, SENSOR DISABLED - (MCO$_2$).** The airway adapter (cuvette) may be contaminated or the light source in the sensor may be faulty. Clean or replace the cuvette as required or replace the CO$_2$ sensor.

**SENSOR FAILURE, CALIBRATION ERROR - (MCO$_2$).** A Sensor failure has occurred. Replace the sensor.

**PUMP FAILURE, SERVICE REQUIRED - ($SCO_2$).** The sidestream pneumatic tubing is kinked or a pump failure on the SSP board has occurred. Correct the tubing problem or replace the SSP board as required.

**DEGRADED WAVEFORM-SERVICE REQUIRED - ($SCO_2$).** This error indicates possible contamination or light source failure in the $CO_2$ measurement chamber (bench) that is located on the Stick board or by a failure of the SSP Board. Replace the Stick or SSP board as required.

**LACK OF WAVEFORM-SERVICE REQUIRED - ($SCO_2$).** This error indicates possible contamination or light source failure in the $CO_2$ measurement chamber (bench) that is located on the Stick board or by a failure of the SSP Board. Replace the Stick or SSP board as required.

**MOTOR FAILURE-SERVICE REQUIRED - ($SCO_2$).** The motor drive in the $CO_2$ bench has failed. Replace the Stick board.

**CALIBRATION ERROR-SERVICE REQUIRED - ($SCO_2$).** A $CO_2$ bench failure has occurred. Replace the Stick board.

**OCCLUSION-CHECK EXHAUST PORT/TUBING - ($SCO_2$).** Repeated error messages after removing any occlusion on the exhaust connector can indicate a defective pump located on the SSP board. Replace the SSP board.

## Non-Recoverable Error Codes

Non-recoverable errors are detected by software and indicate the Propaq Encore is no longer able to function properly and must be returned to Protocol for service. Contact Protocol Technical Support.

When a non-recoverable error is found, the software attempts to put the error message and its number on the Propaq Encore display. All monitoring functions are locked out. Non-recoverable errors are therefore distinct from equipment alerts, which permit reduced monitoring capability.

Non-recoverable errors are indicated in the following format:

**x - yyy -zzzz**

where:

x = 0 indicates a problem found by the Display Control Processor (DCP).

x = 1 indicates a problem found by the Data Acquisition Processor (DAP).

x = 2 indicates a problem found by the Printer Control Processor (PCP) on the Printer Main board.

x = 3 indicates a problem found by the $SpO_2$ Control Processor (SCP) on the SCP board.

x = 5 indicates a problem found by the Main Stream Processor (MSP) on the MSP ($CO_2$) board.

x = 7 indicates a problem found by the Side Stream Processor (SSP) on the sidestream main board.

yyy-zzzz indicate specific types of problems. Contact Protocol Systems Technical Support for more details.

## Battery Capacity Check

Several variables affect monitor operating time on battery:

- active options
- frequency of NIBP measurements
- frequency and length of printouts
- ambient temperature,
- battery age and condition
- displayed information.

Refer to the *Propaq Encore Reference Guide* for battery care information and expected operating times. If the monitor fails to operate on battery for an extended period of time, follow the procedure below to check the capacity of the Encore's lead acid battery. Lead acid batteries have a very limited shelf life; you must test the battery if the Encore has been stored for two or more months without the ac power adapter plugged in.

CAUTION

**A new battery should pass the following test. The run time of older batteries will decrease proportionally with age. Replacement is recommended when the run time becomes insufficient for the monitor's intended application.**

1. Use the ac power adapter and charge the monitor for at least 8 hours with the monitor turned off (12 hours if a printer or pulse oximeter is attached).
2. Disconnect the cuff and all cables from the monitor.
3. Turn off all printing (if a printer is attached).
4. Disconnect the power adapter.
5. Turn on the monitor.
6. Run the monitor for 4 hours.
7. Check that the monitor did not automatically turn off.
8. Press MAIN MENU.
9. Use the ac power adapter and charge the monitor for at least 8 hours with the monitor turned off. (Charge at least 12 hours if a printer or pulse oximeter is attached.)

# Section 5
# Repair Procedures

## Introduction

This section provides instructions for removing and replacing serviceable modules in the:

- Propaq Encore monitor
- expansion module (which may include any or all of the following: printer, $SpO_2$, mainstream $CO_2$ ,sidestream $CO_2$)
- $SpO_2$-only module

Instructions on how to remove the battery pack are followed by instructions on how to disassemble the monitor, the expansion module, the printer, the $SpO_2$ module, and the $CO_2$ module.

note...

**In general, re-assembly procedures are the opposite of the disassembly procedures. If there are items to note during re-assembly, they are described after the disassembly section.**

**WARNING**

**Whenever the monitor is opened for calibration or repair, a risk (leakage) current safety check and a hi-pot test must be performed followed by a complete functional verification. These procedures are located in Section 2.**

## Propaq Encore Software

Propaq Encore system software is contained in PROMs (programmable read-only memory) on various system board. The following PROMs may require replacement during board exchange processes. Refer to procedure on page 92 for replacement instructions.

- DAP PROM on the analog board in the Encore monitor
- PCP PROM on the printer main board in the Expansion Module
- SCP PROM on the SCP board in the $SpO_2$ option
- MSP PROM on the $CO_2$ board (MSP) in the Expansion Module
- SSP PROM on the sidestream main board (SSP) in the Expansion Module

When you remove one of these boards for replacement, you should remove the PROM from the board and store it in an anti-static plastic bag until you receive the replacement board. Keeping the PROM allows you to install it in the new board and ensures the replacement board will be compatible with the rest of your Encore system software.

*note...*

**The DCP PROM and the digital board are not field replaceable due to external programming requirements. Do not remove the DCP PROM. For digital board service and/or a DCP software update, contact your Protocol Service representative.**

WARNING

**STATIC DISCHARGE WARNING**
**All calibration, service, and repair must be done at a static-protected work station. Failure to protect against damage due to static discharge may reduce monitor operation life and increase repairs. Place the monitor in an anti-static area before servicing the monitor.**

## Required Tools

The following tools are required to disassemble and reassemble the Propaq Encore components.

**Required Tools**

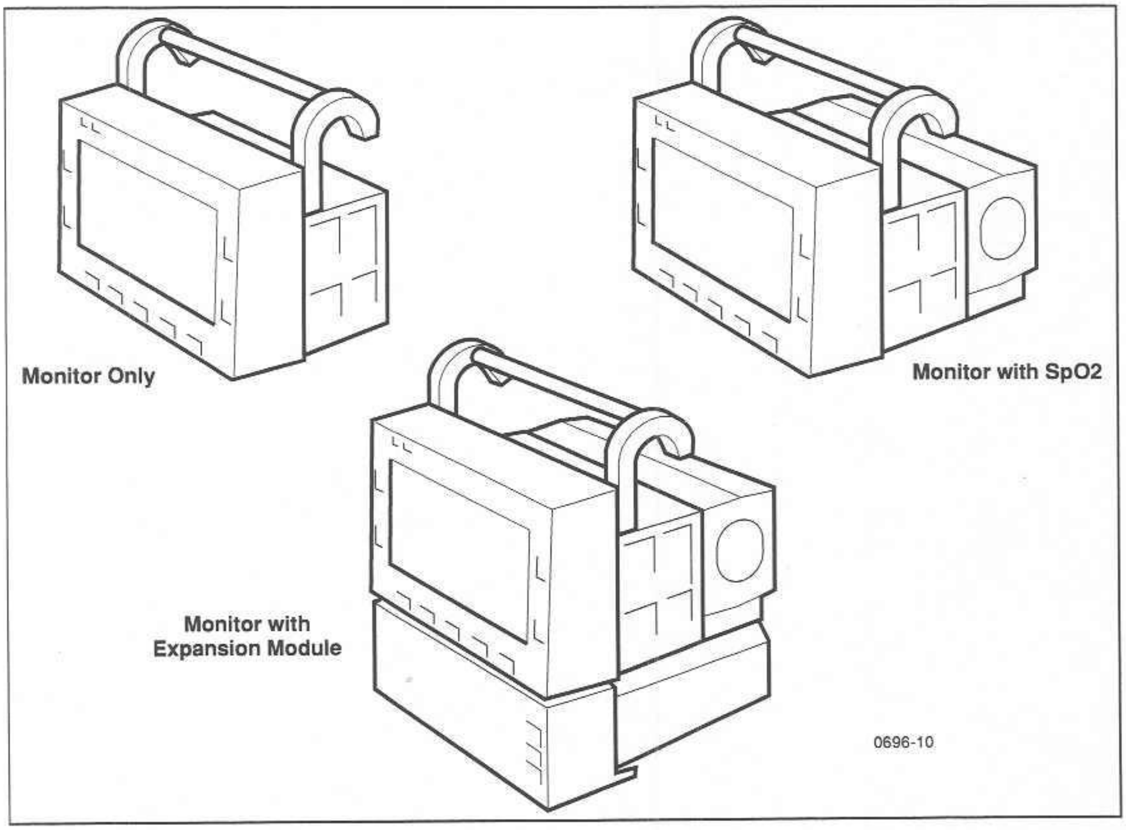
| Description |
|---|
| Phillips screwdrivers, #1 and #2 |
| Flat blade screwdriver |
| Adjustable torque screwdriver (2.5in-lb to 7.35in-lb.; .43N-m to .83N-m), with Phillips and 3/16" nut driver heads |
| Tweezers to help with screw removal and replacement |
| Static-free mat and wrist band equipment |
| Wire cutter to remove tie wraps |
| Tie wrap tool |
| De-ionized (neutralized), filtered, dry, non-combustible gas under pressure for removing any dust or debris from the monitor's interior. |
| Pliers, standard needle-nosed |
| Pliers, looping - non-serrated, rounded edges for use on tubing |
| PROM Remove Tool: Amp Part Number 821903-1 |

CAUTION

**It is recommended you use de-ionized gas for removing dust and debris prior to reassembly of monitor components. Commercial devices are available to neutralize compressed gases.**

### Propaq Encore Options

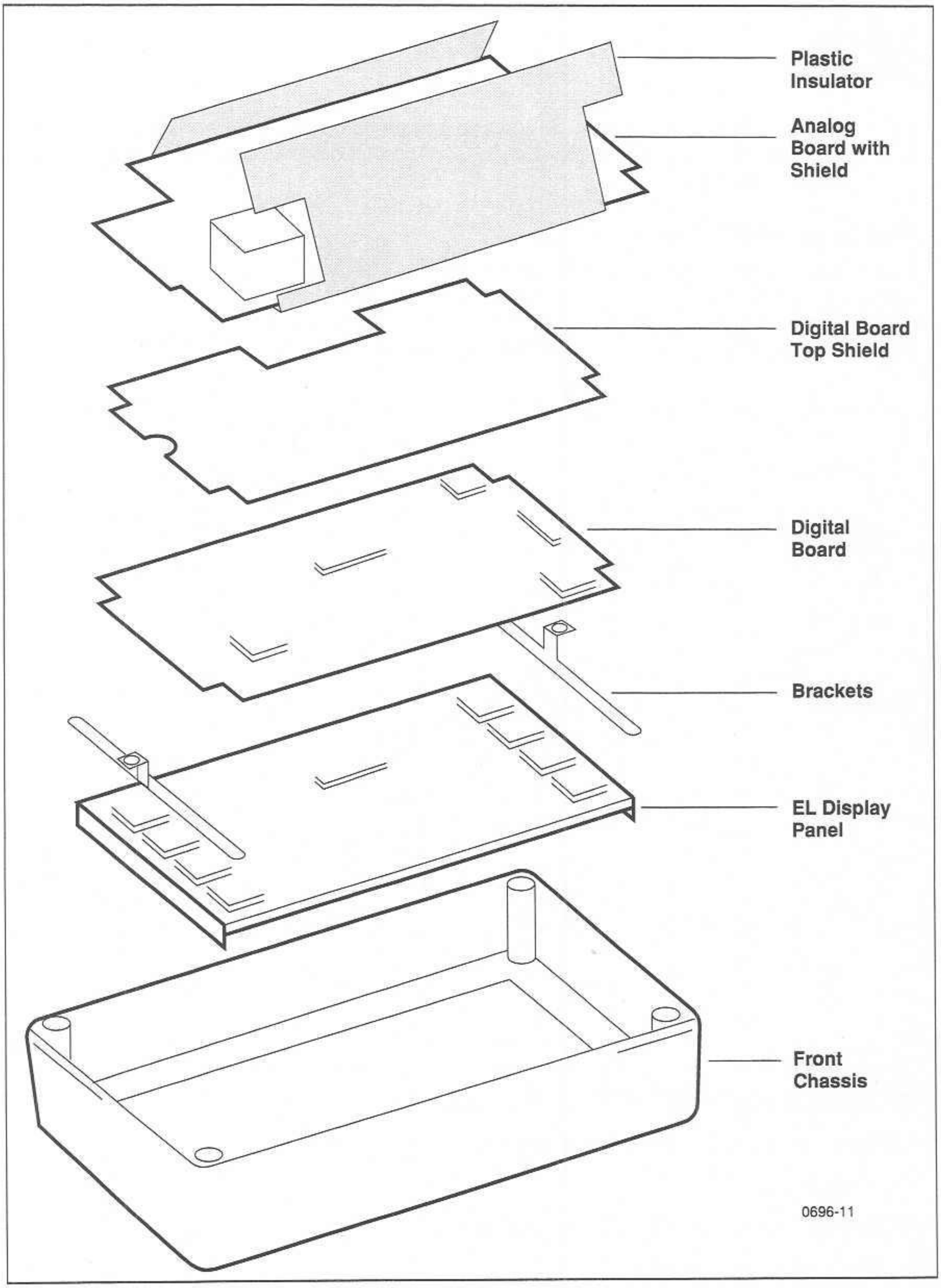
Your Propaq Encore may contain an option module that attaches to the monitor. You must remove the option module before you can disassemble the monitor. For instructions on how to remove the expansion module, refer to **Replacing the Battery Pack** on page 71. For instructions on how to remove the SpO$_2$ module, refer to **Removing the Dual Battery in SpO2 Module** on page 75.



## Field Replaceable Units in the Monitor

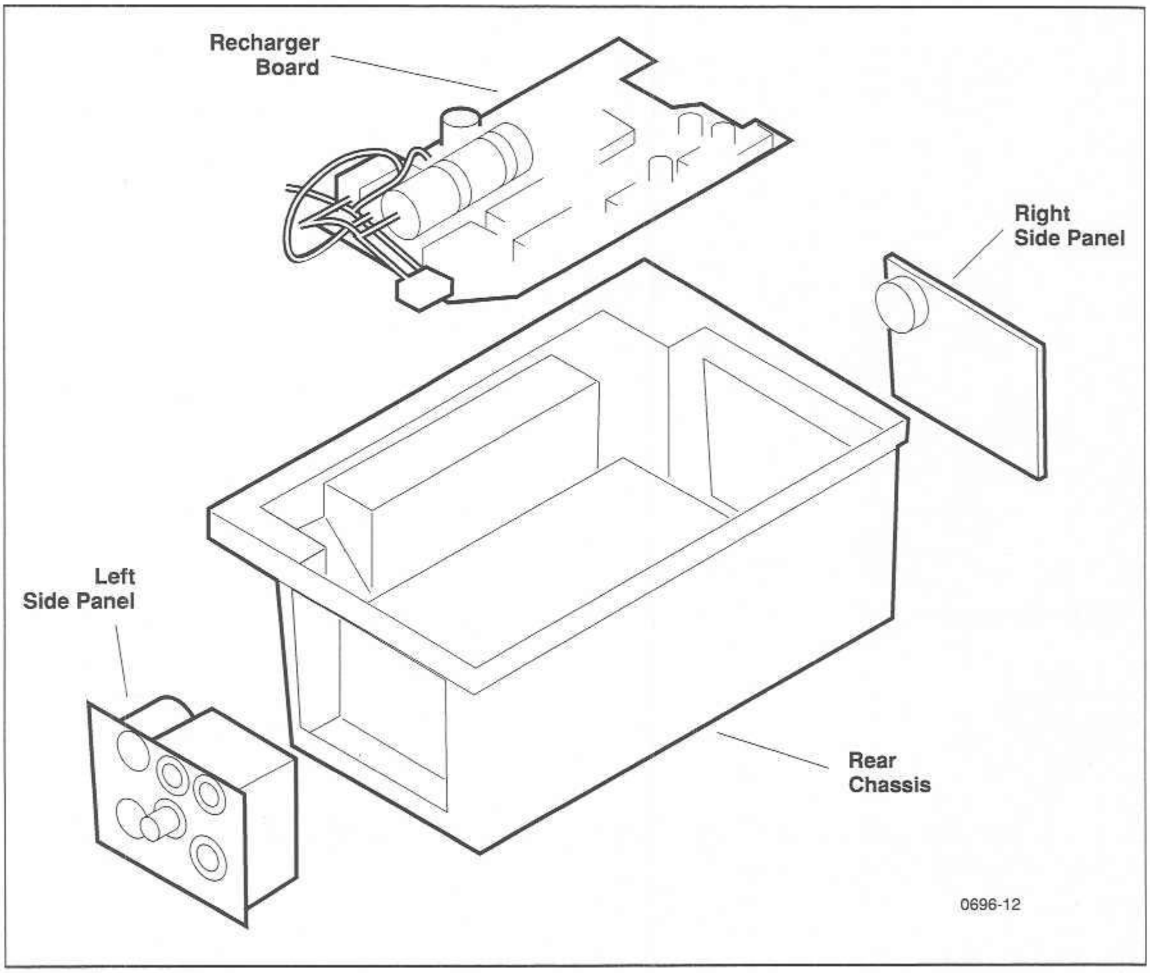
The front chassis of the monitor contains the following components:

- insulator
- Analog board with metal shield and insulator
- Digital board with shields
- EL display unit
- front chassis with display filter and gasket


Plastic Insulator
Analog Board with Shield
Digital Board Top Shield
Digital Board
Brackets
EL Display Panel
Front Chassis
0696-11

The rear chassis contains the following components:

- Recharger board
- Side panels (right and left)
- NIBP pump
- NIBP tubing
- NIBP valves

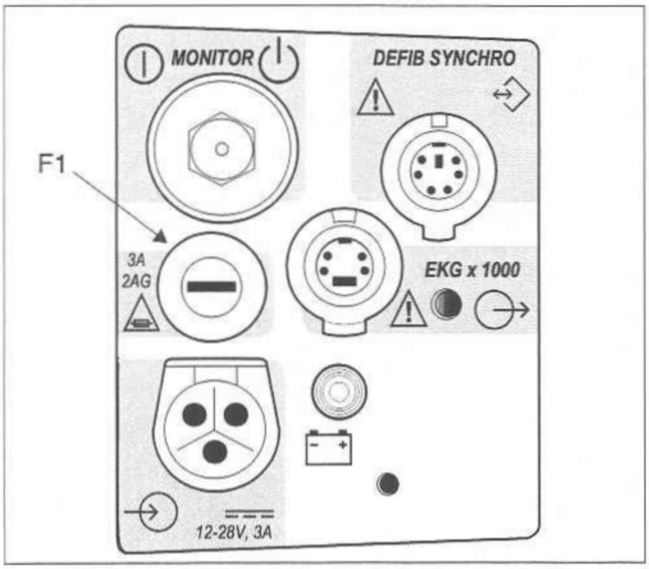

Recharger Board
Right Side Panel
Left Side Panel
Rear Chassis
0696-12

## Replacing the Power Input Fuse

The F1 fuse protects the Recharger board circuitry against excessive current at the dc input connector. You do not need to disassemble the Propaq Encore to replace this fuse.

Check fuse F1 if the ac power adapter is functioning properly and the following two conditions exist:

- the green LED charging indicator on the monitor's right side panel does not illuminate
- the monitor battery does not charge



To remove the fuse, use a flat blade screwdriver to turn the fuse cover and release the fuse.

**CAUTION**

**Replace the fuse only with one of the same rating and size. See Section 7 for Protocol part numbers.**

## Replacing the Battery Pack

**WARNING**

**Although the battery pack includes a fuse to prevent against personal and equipment damage, the sealed lead-acid battery pack is capable of quickly delivering dangerously high currents if improperly handled, misused, or abused. These current levels may burn skin or damage the Propaq Encore. Use extreme caution when handling the battery pack.**

**The battery fuse is not replaceable. If the battery is shorted, the entire pack must be replaced. Do not try to service the battery fuses.**

Insert a new battery pack into the Propaq Encore when the current battery no longer holds an adequate charge. Verify the battery charges to capacity according to the **Battery Capacity Test** in Section 4.

Dispose of used battery promptly. Keep away from children. Do not disassemble and do not incinerate or burn.

BATTERIES MUST BE SEPARATED
FROM OTHER DISPOSABLES FOR
RECYCLING

The battery maintains programmed defaults and time of day. Without the battery, the values for these items return to the factory settings. If the power up error message TIME/DATE SETTINGS LOST is displayed, reprogram the time and day and monitoring default parameters according to the procedures described in the *Propaq Encore Reference Guide.*

**WARNING**

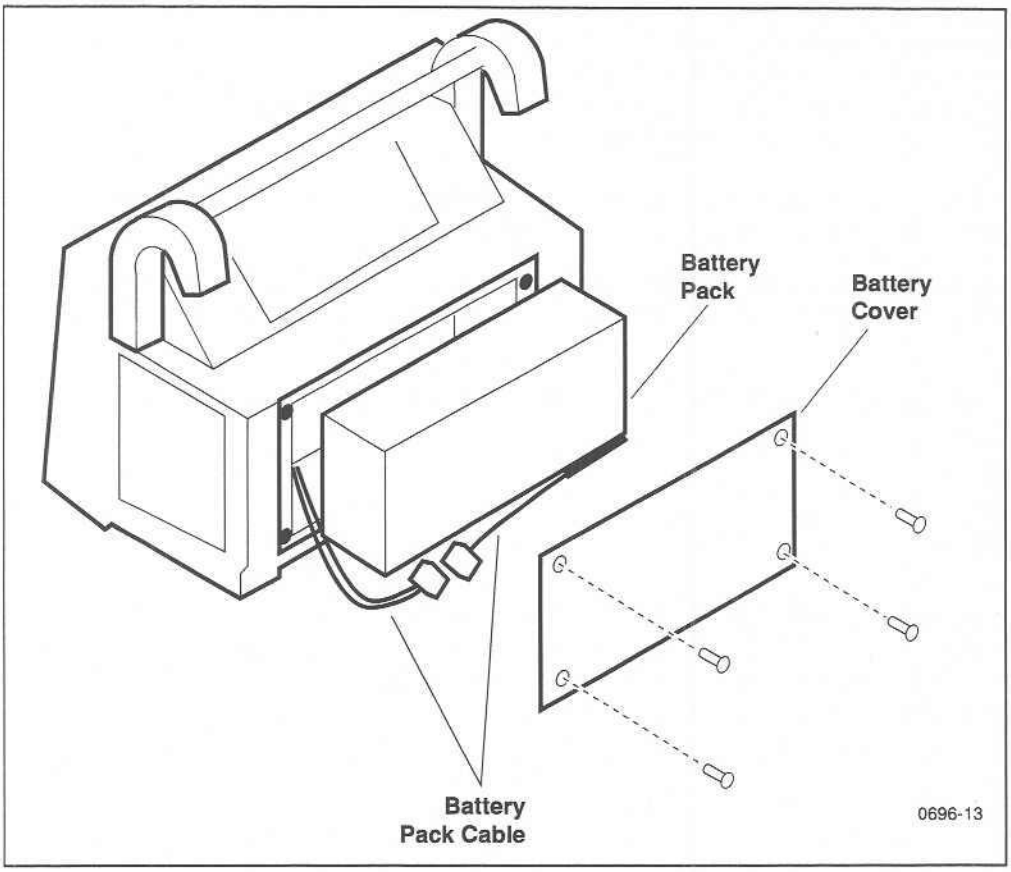
**Do not pinch the battery wires when inserting the battery pack into the Propaq Encore. Monitor failure or fire could occur if wires get pinched.**

You must remove the battery pack before opening the monitor case and replacing components. A Propaq Encore without options contains a single battery pack. An Encore with an option package uses a dual battery package.

## Removing the Single Battery Pack

The following steps describe how to remove the battery pack from the monitor:

1. Using a flat blade screwdriver, unscrew the four screws securing the battery pack cover as shown below.


Battery Pack
Battery Cover
Battery Pack Cable
0696-13

2. Disconnect the battery pack cable from the battery pack.
3. Remove the battery pack from the monitor.
4. Store the battery in a safe place while disassembling the monitor.

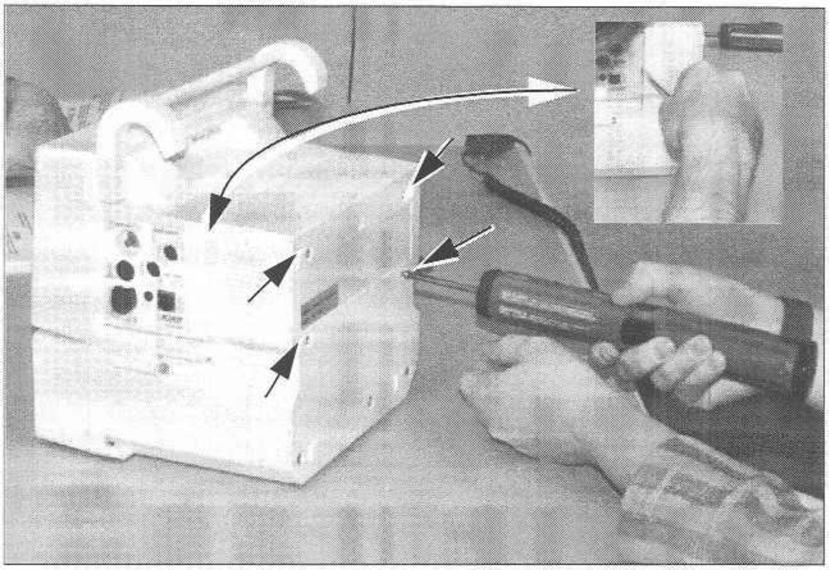
## Removing the Dual Battery in Expansion Module

The expansion module uses a dual battery pack. The following instructions describe how to remove the dual battery.

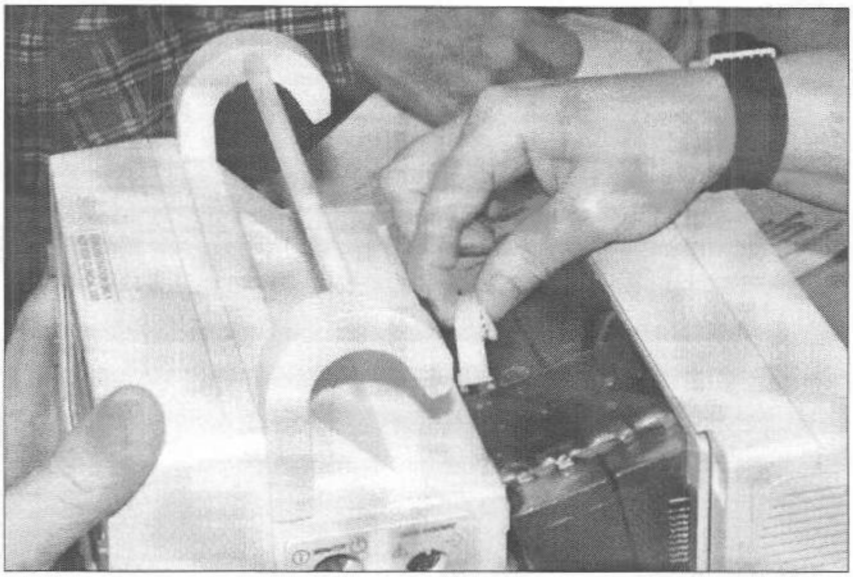
*note...*

**Four screws secure the expansion module to the monitor. Four additional screws secure the rear panel to the expansion module chassis; do not remove these additional screws.**

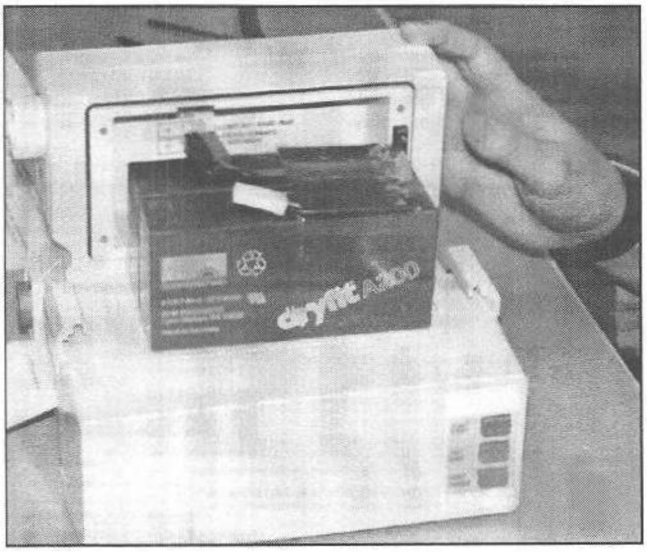
1. Using a Phillips screwdriver, remove the four screws securing the expansion module to the monitor (see figure below).



2. Use the flat blade screwdriver to gently loosen the expansion module from the monitor (see inset above).
3. Slide the monitor forward until you can disconnect the battery pack cable from the monitor's power cable (see figure on page 74). The battery pack should remain in the expansion module chassis.



4. Continue to slide the monitor forward until it can be completely separated from the expansion module.
5. Slide the dual battery pack forward out of the expansion module until the battery connector can be reached.
6. Disconnect the battery connector from the expansion module (see figure below).



7. Remove the dual battery pack from the expansion module.
8. Store the battery in a safe place while disassembling the monitor and expansion module.

### Removing the Dual Battery in $SpO_2$ Module

The steps for removing the battery pack from the $SpO_2$ module are identical to those in removing the battery from the expansion module, except you remove all screws on the rear panel. The monitor is secured to the $SpO_2$ module with four screws; each screw has two washers.

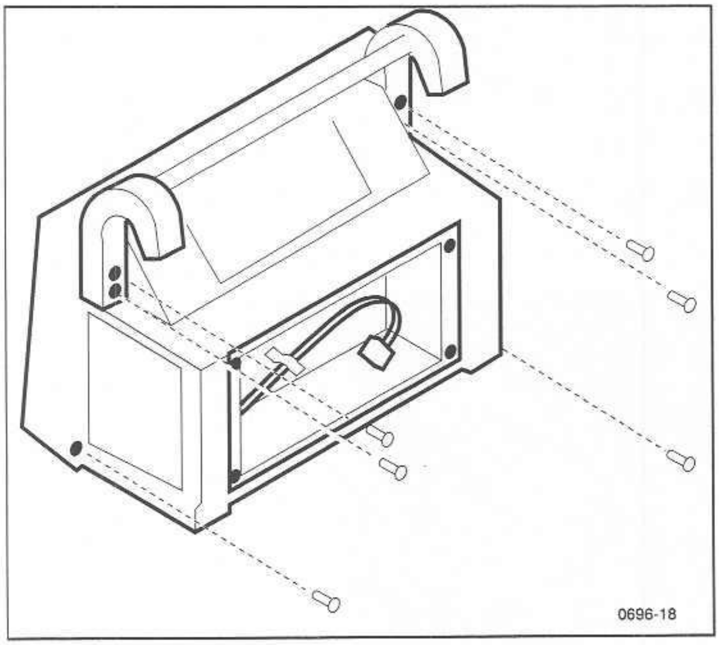
1. Using a Phillips screwdriver, remove the four screws from the $SpO_2$ module rear panel.
2. Slide the monitor forward until you can disconnect the battery pack cable from the monitor's power cable.
3. Slide the monitor forward until it can be completely separated from the $SpO_2$ module.
4. Remove the dual battery pack.
5. Store the battery in a safe place while disassembling the monitor and $SpO_2$ module.

When attaching the $SpO_2$ module, verify that the continuous O-ring gasket is in place.

## Opening the Monitor

Follow these steps to open the monitor casing and gain access to the three removable monitor boards.

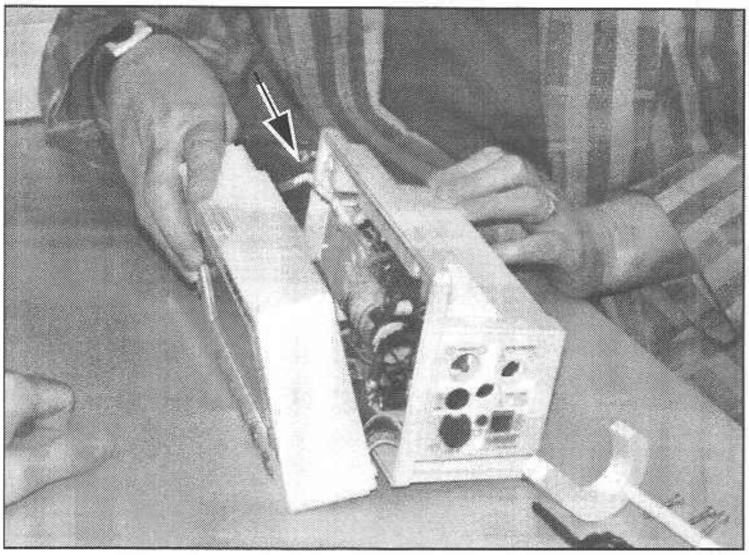
1. Remove the battery pack according to the procedures on page 71.
2. Using a Phillips screwdriver, remove the six screws securing the handle and monitor casing.



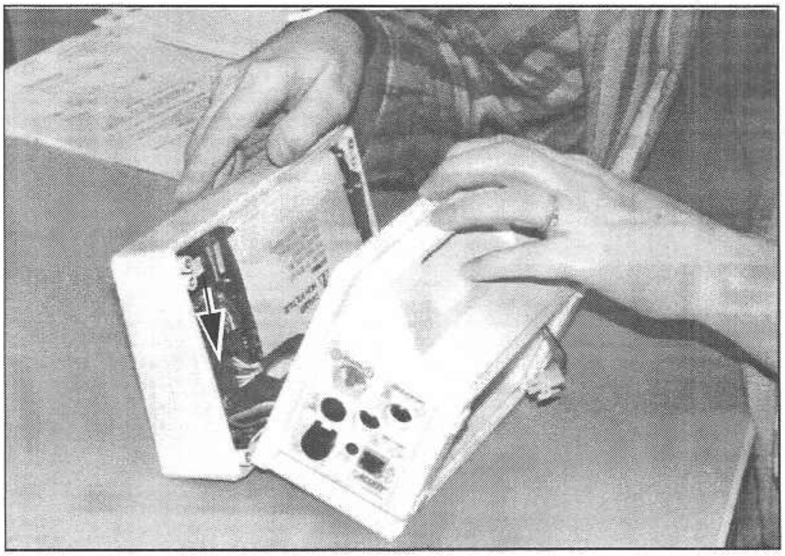
**CAUTION**

**Before opening the casing more than one inch in the next step, disconnect the tube from the pressure transducer at the joint. Failure to disconnect the tubing may cause damage to the transducer or tubing.**

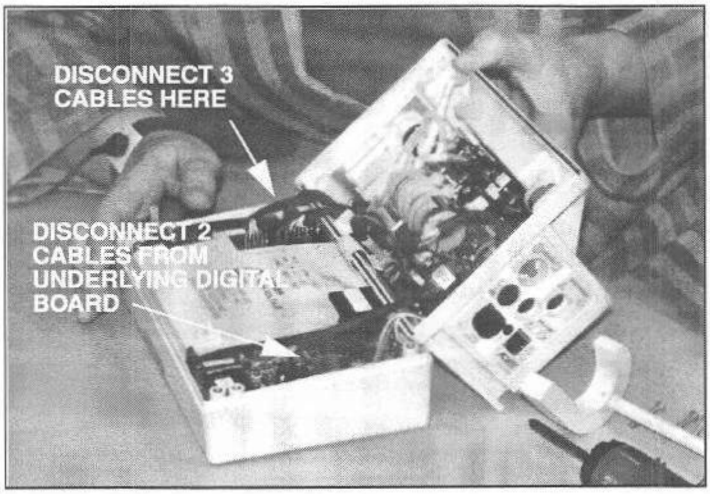
3. Slightly spread the casing open at the top until you can disconnect the pressure transducer tube indicated in the figure below.



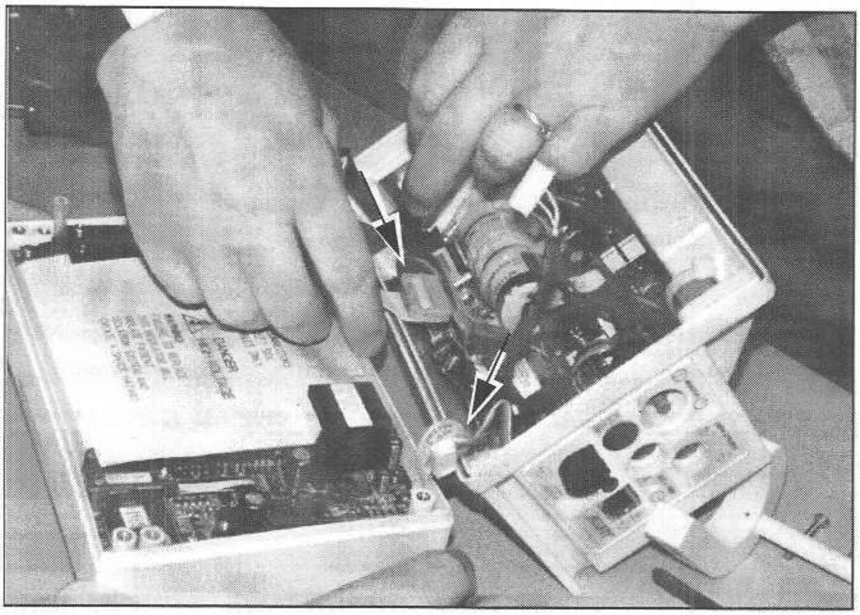
4. Spread the casing open to an angle of 45 degrees.
5. Detach the expansion connector cable (to P1) from the front chassis of the monitor as indicated in the figure below.



6. Spread the casing open to an angle of about 80 degrees.
7. Detach the following cables from the front chassis (indicated in figure below):
   - Cable to P5 on the Analog board, from the left side panel ECG connector on the rear chassis.
   - Cable to P6 on the Analog board, from the left side panel IPB connector on the rear chassis.
   - Cable to P7 on the Analog board, from the left side panel temperature jack on the rear chassis.
   - Cable to P8 on the lower (Digital) board, from the right side panel on the rear chassis.
   - Cable to P9 on the Digital board, from the right side panel on the rear chassis.



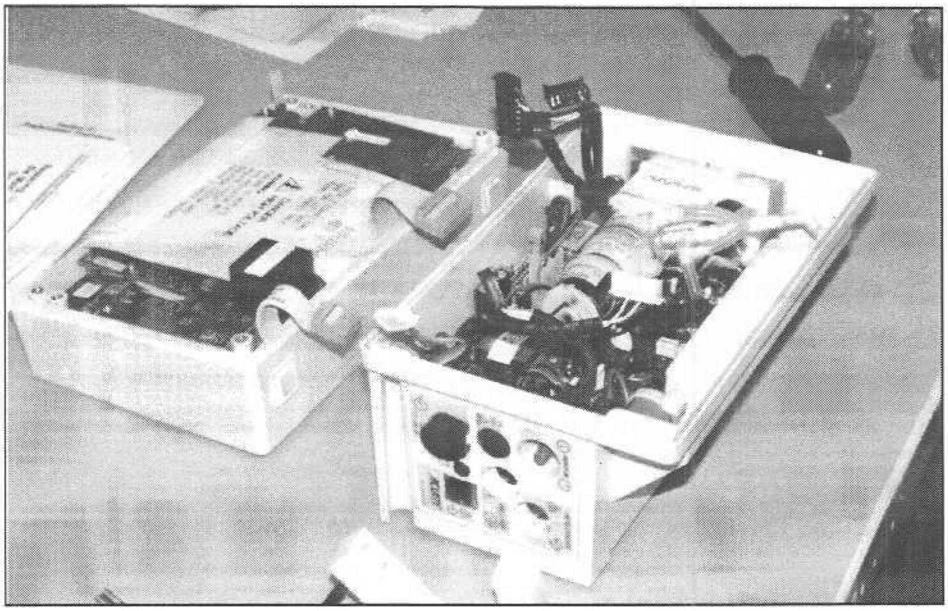
8. Detach the two ribbon cables from the rear chassis (indicated in figure on page 78):
   - Ribbon cable to P10 on the Recharger board, from the Digital board.
   - Ribbon cable to P11 on the Recharger board, from the Digital board.



note...

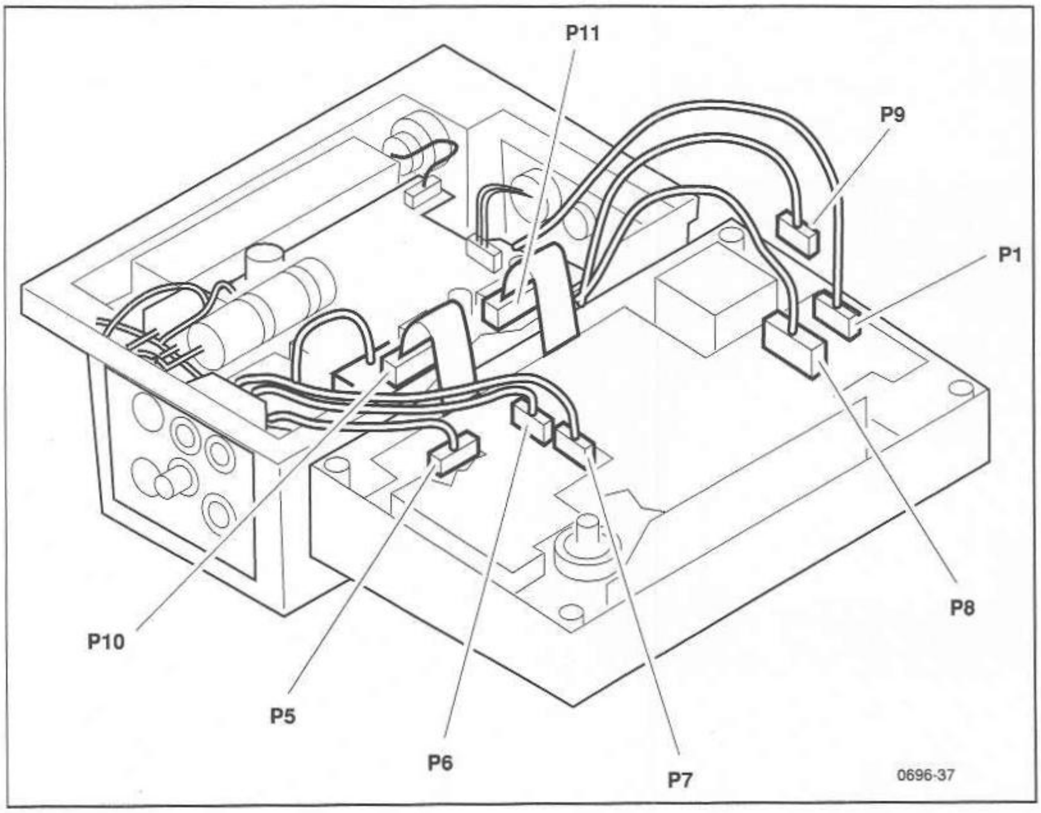
**The two halves are sealed by rubber O-ring gaskets that are recessed around the perimeter of the rear chassis. If the gaskets become loose, replace them in the perimeter before re-assembling the monitor.**

9. Separate the front chassis from the rear chassis (see figure below).



## Closing the Monitor

1. Before closing the monitor casing, verify the following:
    - Cable to P6 on the Analog board goes behind and below the cable to P5, and over the cable to P7.
    - Cable to P5 on the Analog board goes over and in front of the cable to P6.
    - Cable to P7 on the Analog board goes under the cable to P6.
    - Cable to P1 (the expansion cable) must not lay over the transformer.
    - Cable to P8 on the Digital board rests to the right of the transformer and over the ribbon cable and cable to P9.
    - Cable to P9 lies under the cable to P8.
    - All cables and hoses are not pinched.
    - The front chassis pressure transducer tube has been securely reconnected.
    - The rubber O-ring gasket is in place in the rear chassis.
    - Verify that the P10 and P11 locking clips are secure.



2. Torque the six screws securing the front chassis to the rear chassis to 6.65in-lbs to 7.35in-lbs (.75N-m to .83N-m).

## Replacing the Analog Board

If a problem occurs with the Analog board, return the entire monitor to Protocol for service. See Section 1 for information on Technical Service.

*note...*

**Do not remove the PROM from the Analog board.**

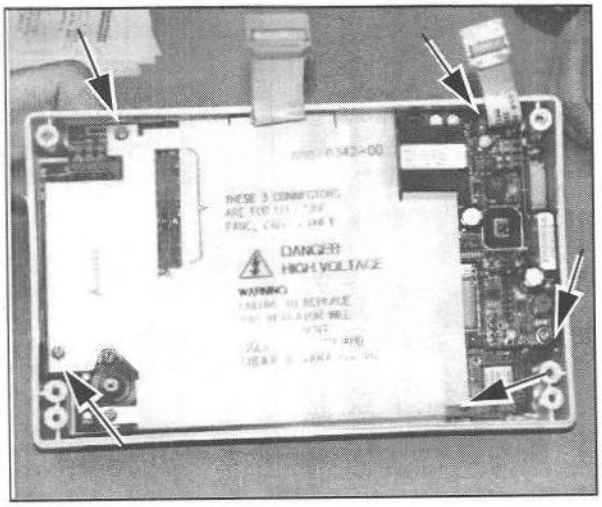
This section provides instructions on removing the Analog board. The Analog board is secured in the front chassis by five screws: three on the right side of the board (side containing the transformer), and two passing through the metal shield on the left side of the board.

*note...*

**You do not need to lift the plastic insulator nor remove the metal shield to remove the Analog board. However, you must lift the insulator to calibrate the board.**

1. Remove the battery pack according to the procedures described in on page 71.
2. Open the monitor according to the procedure on page 75.
3. Remove the five screws fastening the Analog board to the front chassis.

   Note that of the five screws, the two longer screws pass through the metal shield to secure the board.

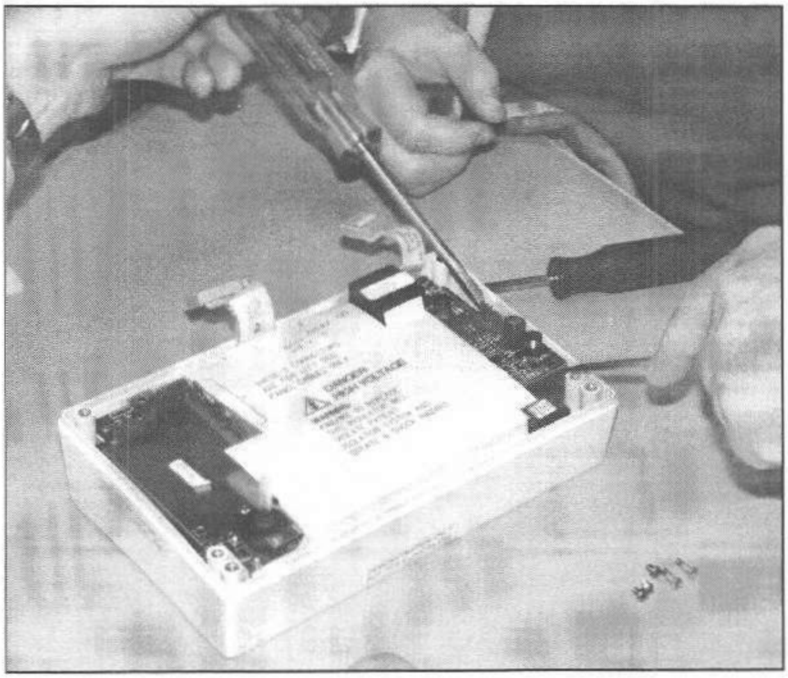


**CAUTION**

**The Analog and Digital boards are connected together on the right side by connectors P4 and J4. It may be necessary to use two flat blade screwdrivers to gently pry the boards apart.**

**Place the screwdriver blades as close to the edge of the board as possible so you don't contact or disturb components on the board. Components are located as close as 1/8" to the edge of the board. Use extreme caution. Try not to flex the board when prying.**

4. Gently lift the Analog board up and out of the front chassis.



When installing the Analog board:

- Blow out any dust and particulates from the board using pressurized de-ionized gas before installing it.
- Align the board so that P4 correctly plugs into J4.
- Torque the screws holding the Analog board to 3.8in-lbs to 4.2in-lbs (.43N-m to .47N-m).

# Replacing the Digital Board

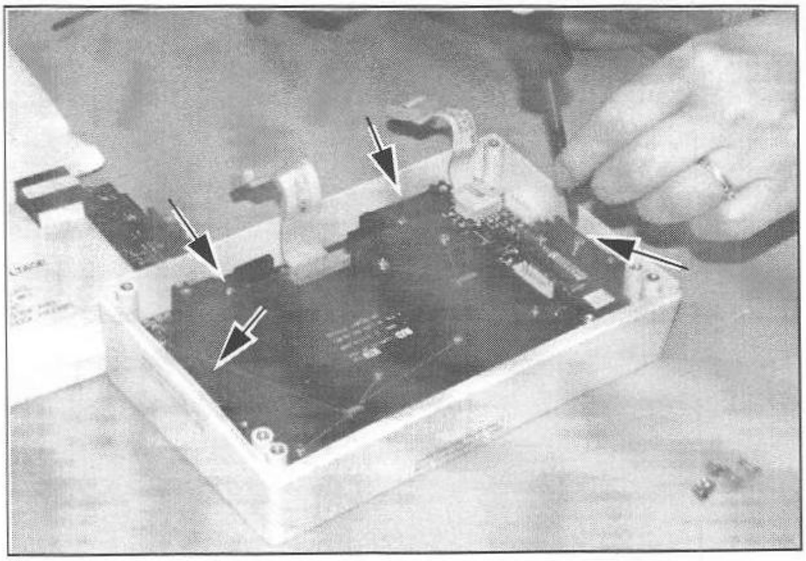
If a problem occurs with the Digital board, return the entire monitor to Protocol for service. See Section 1 for information on Technical Service.

*note...*

**Do not remove the PROM from the Digital board.**

The Digital board is secured beneath the Analog board by four screws and one hex post. The four screws are located in the black brackets, the hex post is located in the lower right corner of the board.

1. Remove the battery pack according to the procedures on page 71.
2. Open the monitor according to the procedure described in on page 75.
3. Remove the Analog board according to the procedure on page 80.
4. Remove the four screws fastening the Digital board to the front chassis.



5. Use the nut driver to loosen and remove the hex post.
6. Lift the Digital board up and out of the front chassis.

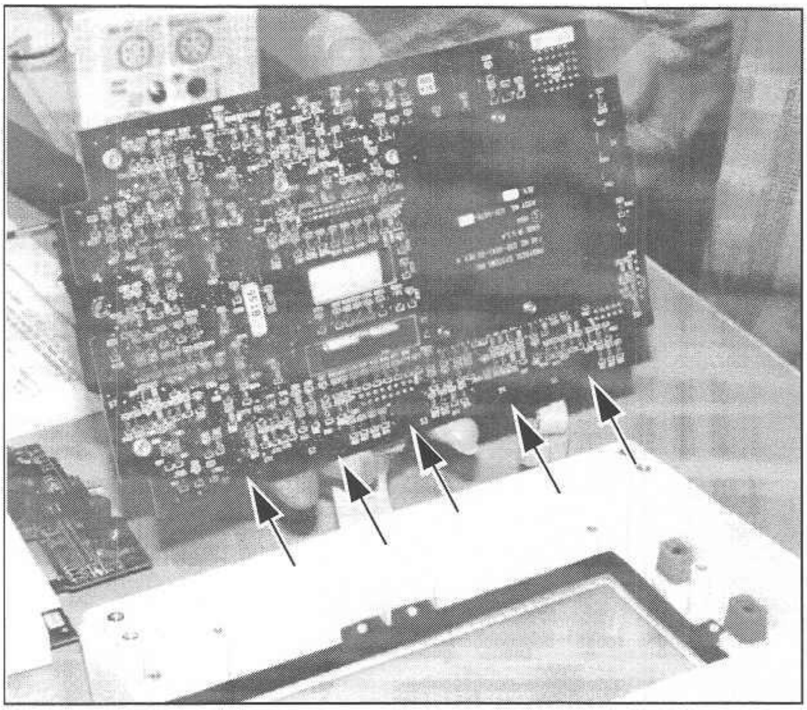
*note...*

**The Digital board is connected to the EL display module by connector J1. This connector should detach easily.**

7. Remove the 10-pin ribbon cable (cable from the Digital board to the Recharger board).

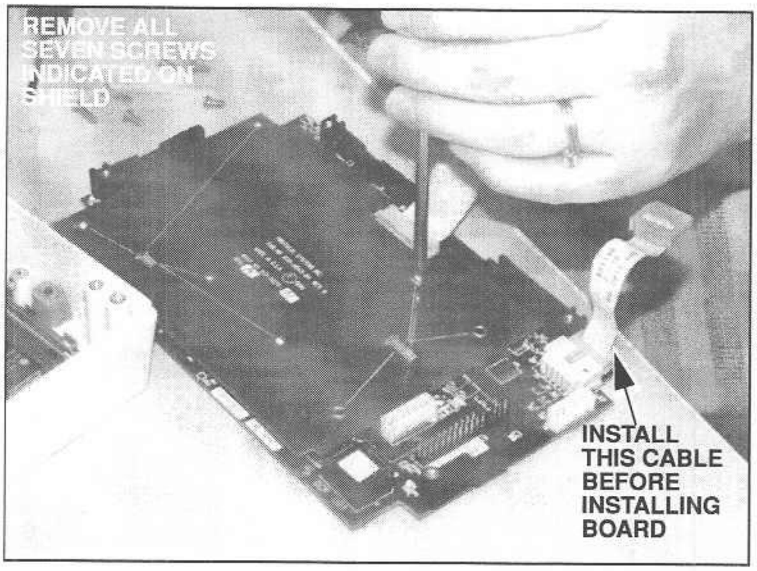
**CAUTION**

**Do not touch the button contact surfaces on the underside of the Digital board. These surfaces must remain clean and oil-free. If you touch them, clean them with a cotton swab moistened with isopropyl alcohol.**

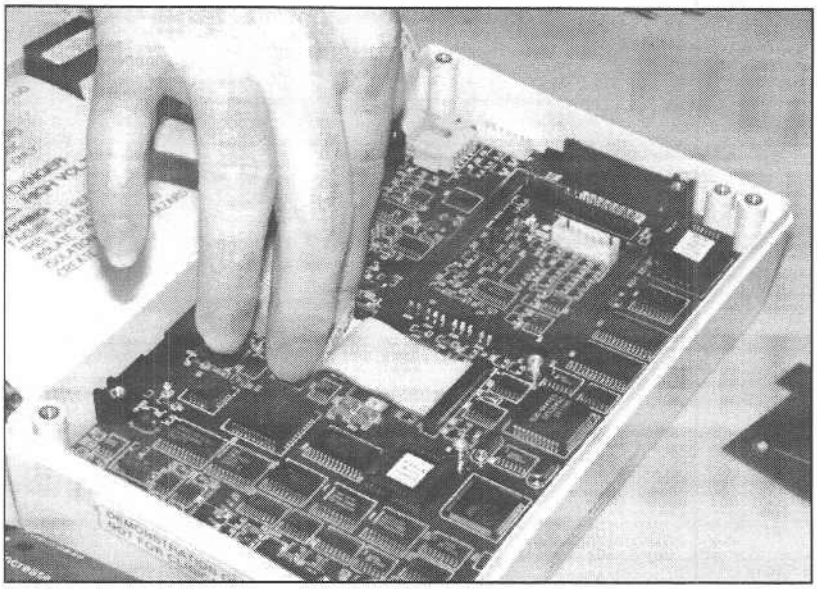


When installing the Digital board:

- Make sure the cable between the Digital board and the Recharger board is installed on the Digital board before placing the board in the front chassis (see figure on page 84).
- Remove the shield on the top of the Digital board in order to reconnect the display cable (see figure on page 84).


REMOVE ALL SEVEN SCREWS INDICATED ON SHIELD
INSTALL THIS CABLE BEFORE INSTALLING BOARD

- Blow out any dust and particulates from the board using pressurized de-ionized gas before installing it.
- Connect the display cable to the Display module.



- Replace the shield, noting the correct screw lengths indicated on the shield. When replacing the insulating shield, make sure the left side of the shield is placed underneath the top surface of the bracket.
- Torque all screws and the hex post to 3.8in-lb to 4.0in-lb (.43N-m to .47N-m).

# Replacing the EL Display Module

**CAUTION**

**Removing the EL display module may damage the electrically-conductive inner surface of the display filter. Protocol recommends leaving the display unit in the front chassis unless you replace the display unit and the front chassis together.**

**The conductive silicone gasket between the display module and display filter may remove the delicate coating from the perimeter of the filter if the gasket peels up as the display module is removed. If electrical contact with the filter is degraded sufficiently, the display's EMI may interfere with ECG and/or $SpO_2$ monitoring if patient cables pass near the display.**

**If you must remove the display module, use two people in the removal procedure to attempt to minimize damage to the display filter.**

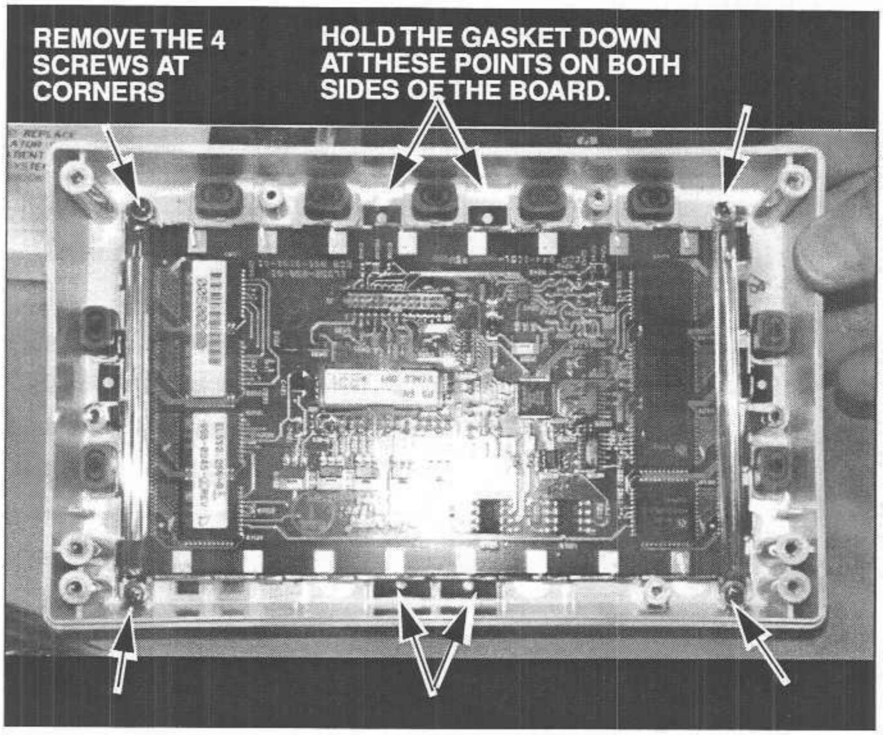
This section provides instructions on how to replace the display module. The display module is attached to the front chassis beneath the Analog and Digital boards by two brackets, each fastened at the top and bottom by a screw and two washers.

Note the voltage indicated on the label of the display module. This value is used for calibrating the display high voltage supply on the Recharger board.

1. Remove the battery pack according to the procedures on page 71.
2. Open the monitor according to the procedure on page 75.
3. Remove the Analog board according to the procedure on page 80.
4. Remove the Digital board according to the procedure on page 82.
5. Remove the screws and washers holding the brackets on the left and right sides of the board.

**CAUTION**

**Handle these brackets carefully. They are constructed of very thin metal. Their purpose is for conductivity, not to secure the display.**



REMOVE THE 4 SCREWS AT CORNERS

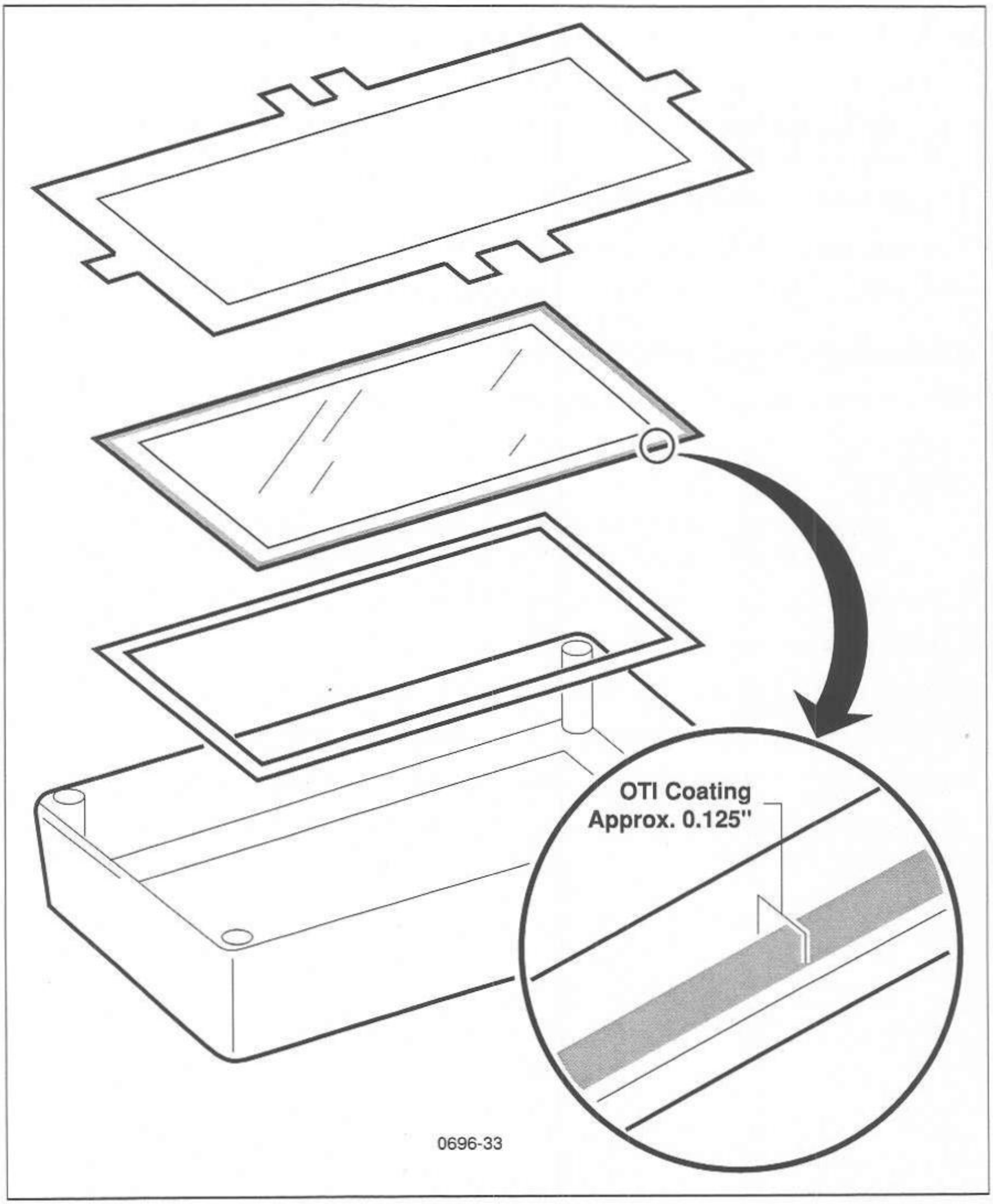
HOLD THE GASKET DOWN AT THESE POINTS ON BOTH SIDES OF THE BOARD.

**CAUTION**

**In the next step, if the gasket lifts off the display filter at any point, you must inspect the display filter to verify that the conductive coating on the filter is still intact. See the steps below.**

6. To carefully remove the display:
    - Using a flat blade screwdriver, each person should hold the silicone gasket down where it is visible between the posts at the top and bottom of the chassis (see figure above).
    - With their free hand, each person should gently lift one side of the display module, attempting to keep the silicone gasket in place on the display filter.

If the gasket lifts off the display filter at any time, inspect the filter beneath the section where the gasket lifted to ensure the conductive coating around the perimeter of the filter is still intact. Try not to disturb the rest of the gasket/filter interface as you do this. To inspect the filter, look for a slight color variation between the perimeter conductive coating and the rest of the filter (see figure on page 87). (Tilting the front assembly at different angles under a bright light can help you see the color variation of the conductive coating.) The slight color variation should be continuous around the perimeter under the gasket. If there is a break in this coating, you must replace the front assembly with the display filter.


OTI Coating
Approx. 0.125"
0696-33

When installing the display module:

- Remove any dust from the display filter using pressurized de-ionized gas.
- Orient the display module so that the J1 connector is toward the buttons.
- Orient the brackets so that the holes on the bracket straps align with the holes in the posts on the sides of the chassis.
- Verify two washers are present for each screw.
- Torque screws to 3.8in-lbs to 4.2in-lbs (.43N-m to .47N-m).
- After the display is in place, blow out any particulate with de-ionized gas.

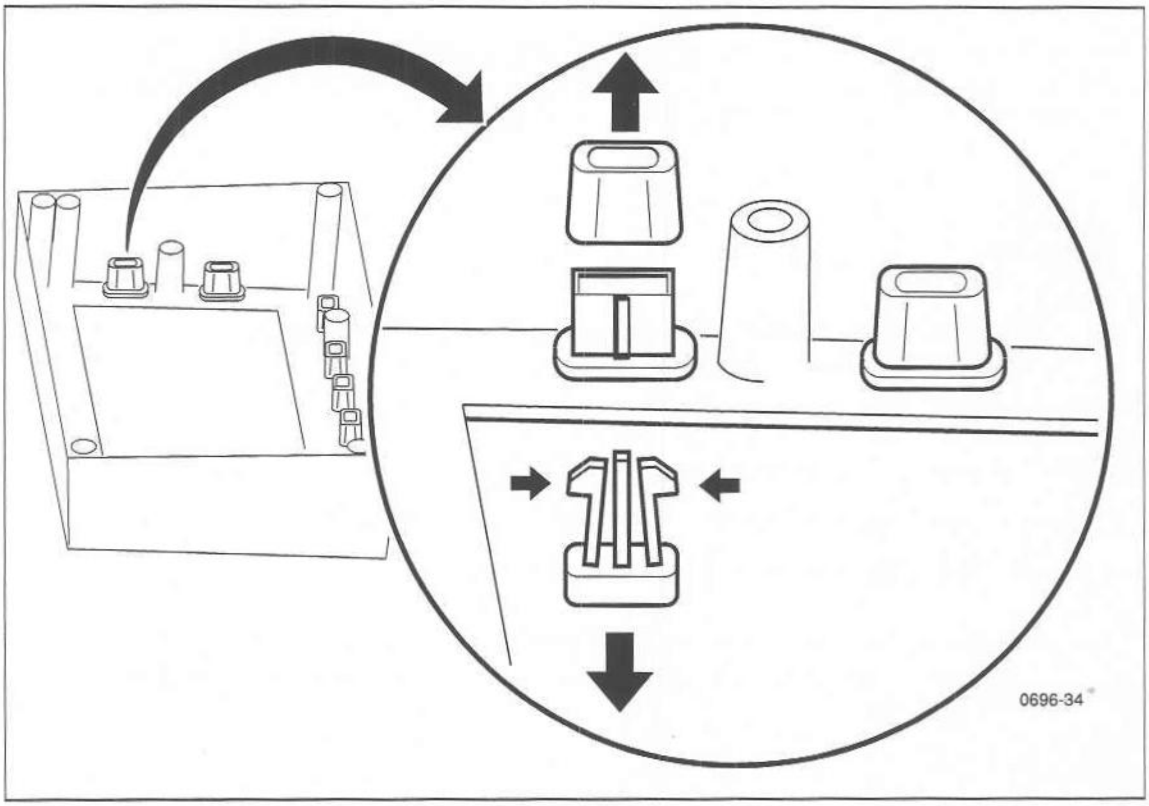
## Removing Front Panel Buttons

This section describes how to remove the front panel buttons.

note...

**You do not need to remove the display module to service the front panel buttons. Buttons can be replaced while the display module remains in the front chassis.**

1. Remove the battery pack according to the procedures on page 71.
2. Open the monitor according to the procedure on page 75.
3. Remove the Analog board according to the procedure on page 80.
4. Remove the Digital board according to the procedure on page 82.
5. Grasp the Silastic™ gray dome and pull the dome off the button post (see figure on page 89).
6. Squeeze the plastic button latches together and then push the button out the front of the panel (see figure on page 89).



note...

**The button dome can be replaced on the post without regard to the orientation of the notch engraved in the dome.**

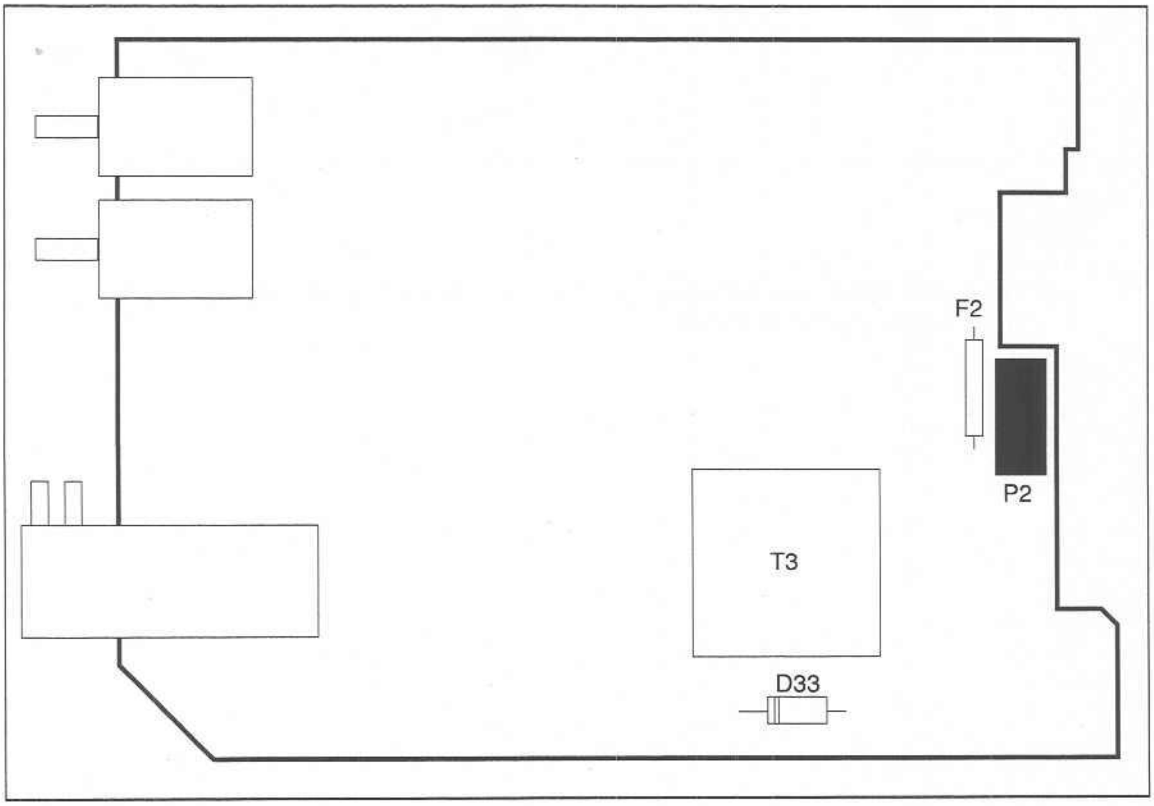
## Replacing Recharger Board Fuse (F2)

The Recharger board fuse (F2) protects the monitor power supply input at the battery line to the monitor. If the monitor does not turn on but the BATTERY CHARGING indicator lights when the ac power adapter is connected, check fuse F2 (3 Amp).

**CAUTION**

**The fuse is heat sensitive and must be soldered with heat sinks in place between the fuse body and the solder joint.**

1. Remove the battery pack according to the procedures on page 71.
2. Open the monitor according to the procedure on page 75.
3. Remove the Recharger board according to the procedure on page 94.
4. Replace the fuse (F2, location is shown in the figure below).

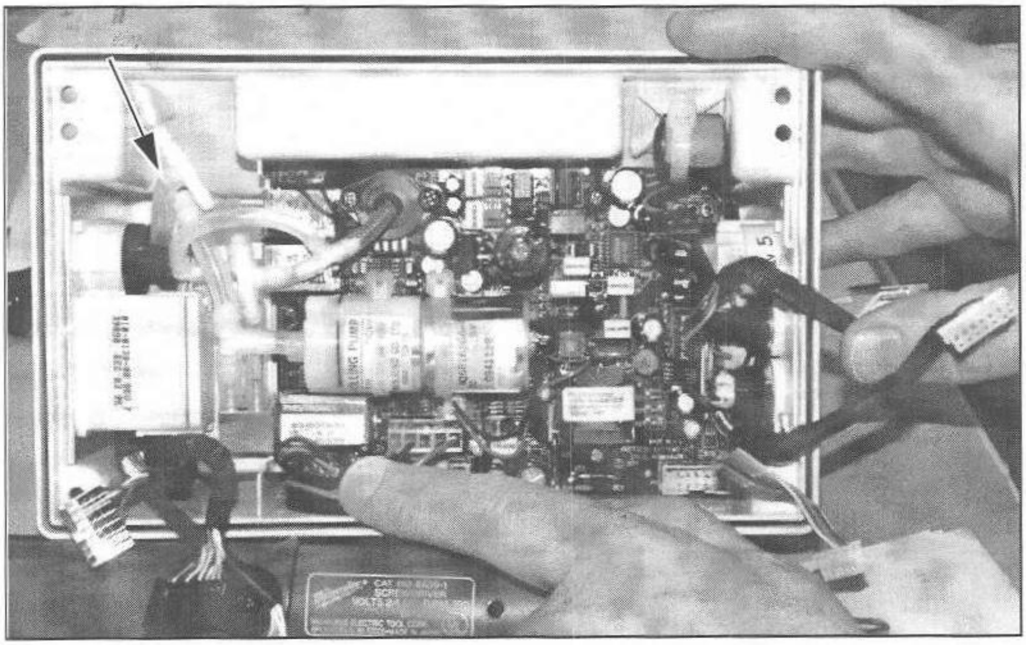


## Replacing Air Tubing

Replace the NIBP tubing as a single assembly to ensure the tubing lengths are accurate. Refer to Section 7 for the tubing assembly part number.

note...

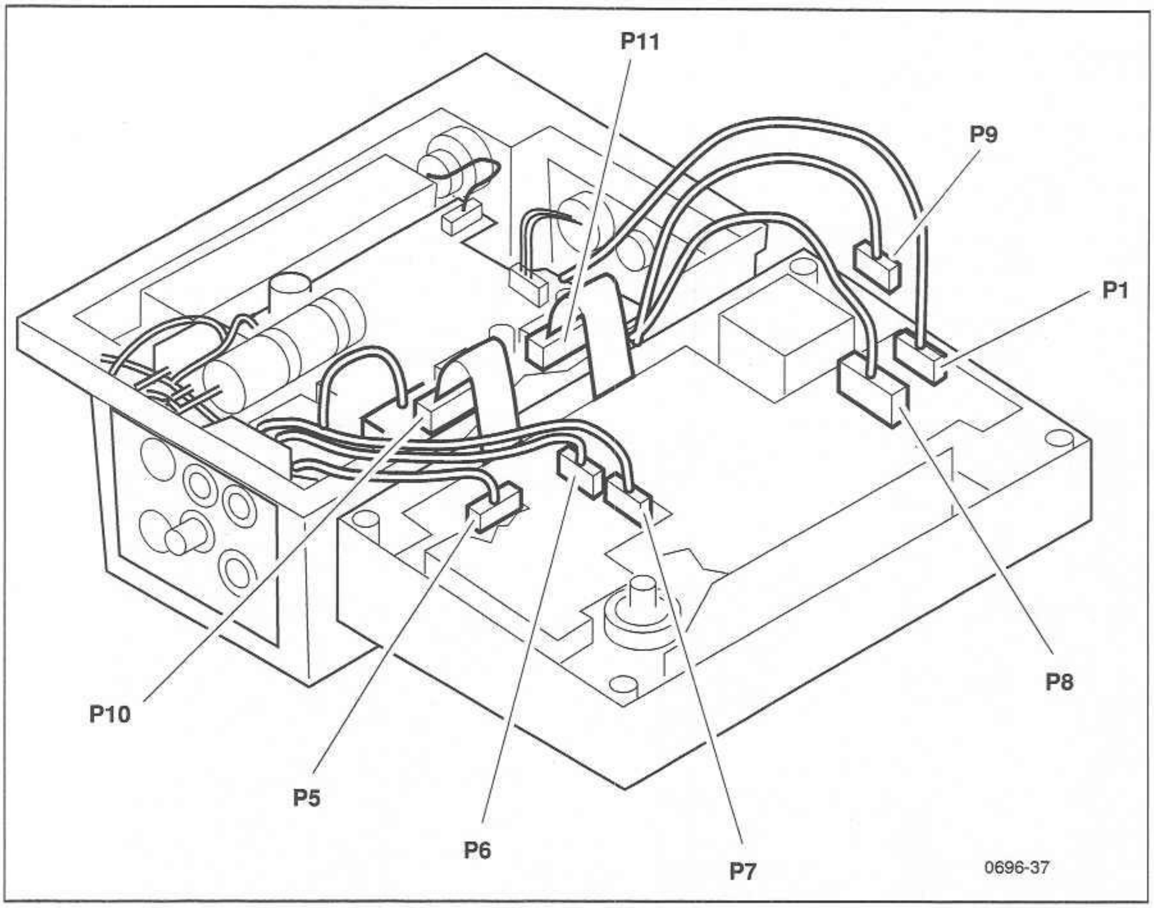
**If you don't need to replace the length of tubing between the cuff hose connector in the left side panel and the rest of the tubing assembly, don't remove the left side panel to disconnect this tube. Leave that length of tubing connected to the side panel but disconnect it from the rest of tubing assembly as indicated by the arrow in the figure below, and replace the tubing assembly.**



## Replacing Cables

If you suspect a cable to be faulty, check its continuity on all pins. If you need to replace a cable, refer to Section 7 for part numbers. See the figure on page 92 for cable locations.

When removing a cable, be sure to note the routing. It is important that the new cable is routed in the same manner.



## Replacing PROMs

Please read the information in **Propaq Encore Software** on page 65.

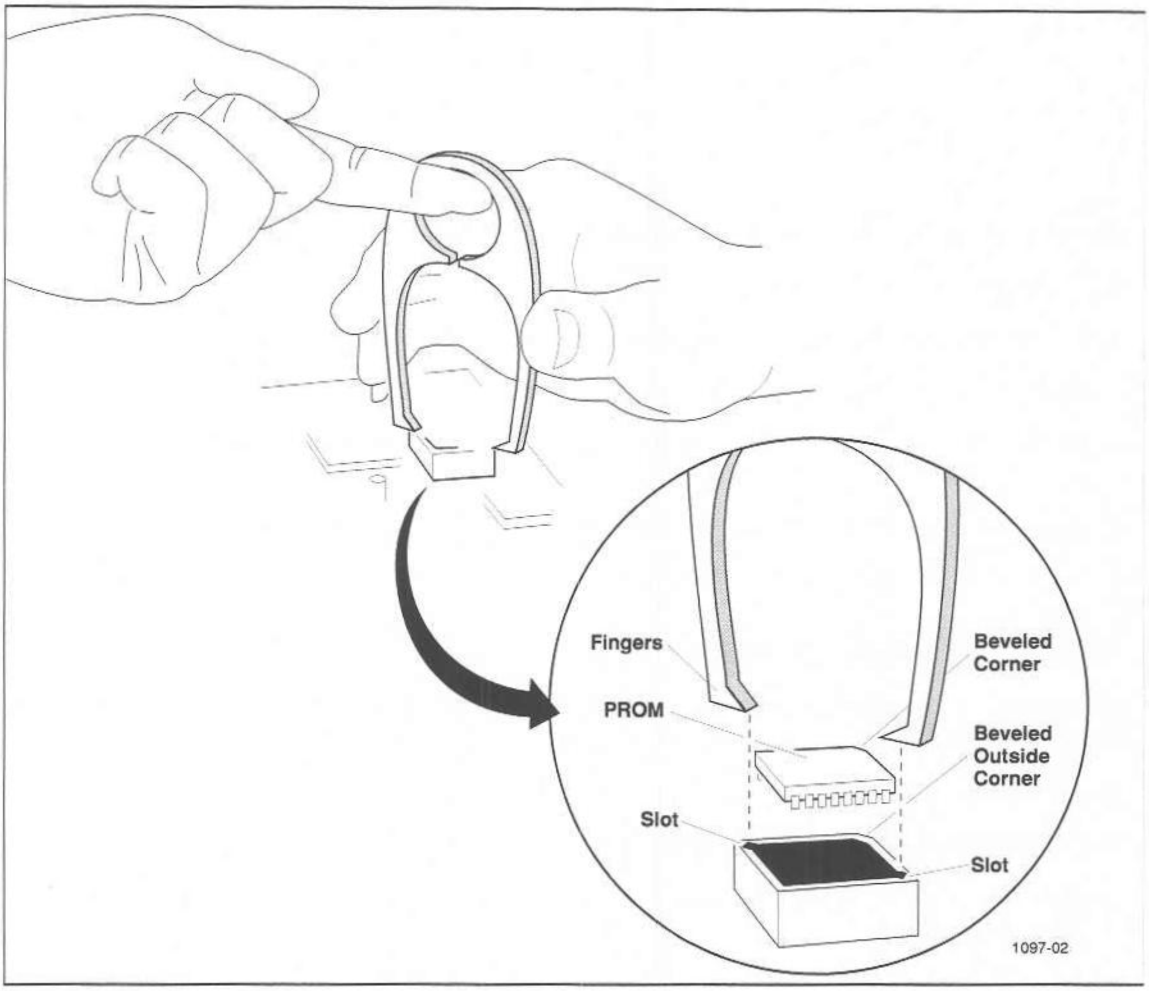
The PROMs require a special removal tool to replace them. See the Required Tools list on page 66. To prevent damage to the PROM sockets, do not use any other tools.

CAUTION

**The PROMs can be damaged by static discharge. Work only at a static-protected work station.**

Do not remove the PROMs from the Analog and Digital board. The following instructions describe how to replace all other PROMs:

- To remove the PROMs, insert the fingers of the PROM removal tool into the slots at two corners of the PROM and pull out the PROM, while squeezing the legs against the PROM.
- To load the new PROM, align the beveled corner of the PROM with beveled OUTSIDE corner of the socket. Carefully press the new PROM into place.



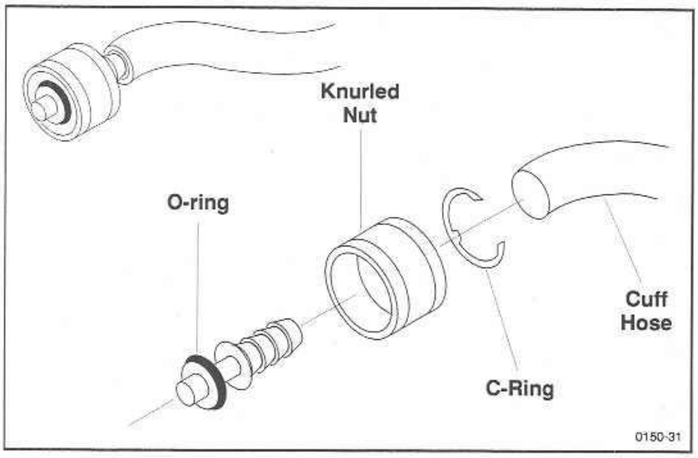
## Cuff Fittings

Air system integrity in the NIBP system is essential to ensure accurate measurements. Routine wear of the O-ring gasket located in the threaded fitting of the cuff hose can result in air leaks. If you encounter air leaks that can not be found from the tests in this manual, replace the O-ring first.

WARNING

**Use of NIBP channel with leaking cuff hose fittings may result in inaccurate non-invasive blood pressure measurements.**

1. Disconnect the cuff hose from the monitor.

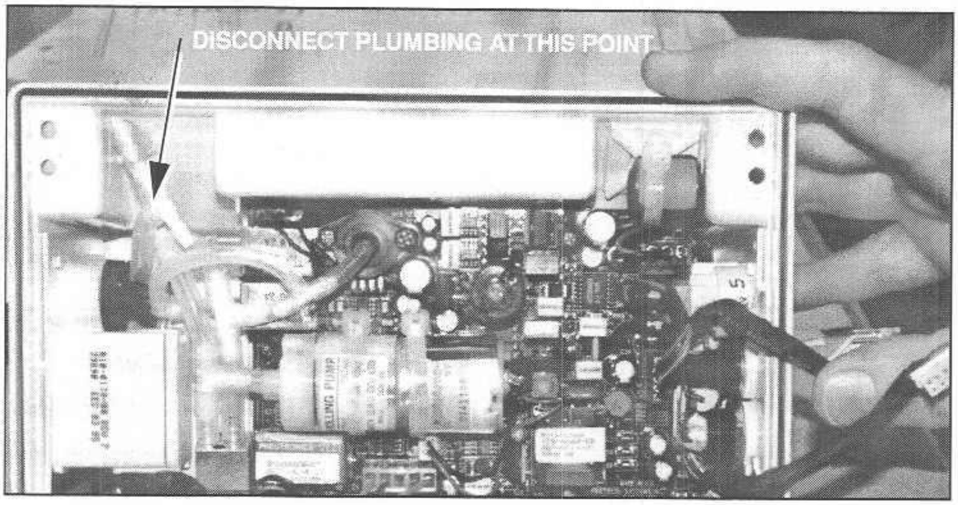


2. Using pliers, pull off the metal fitting from the cuff hose.
3. Cut approximately 1/2" off the cuff hose.
4. Using a small screwdriver, remove the C-clip from the fitting.
5. Remove the knurled nut from the fitting.
6. Remove the O-ring gasket and replace it with a new one, being careful not to nick or otherwise damage the new O-ring.
7. Reassemble the fitting with the knurled nut and C-clip.
8. Press the fitting back onto the cuff hose.

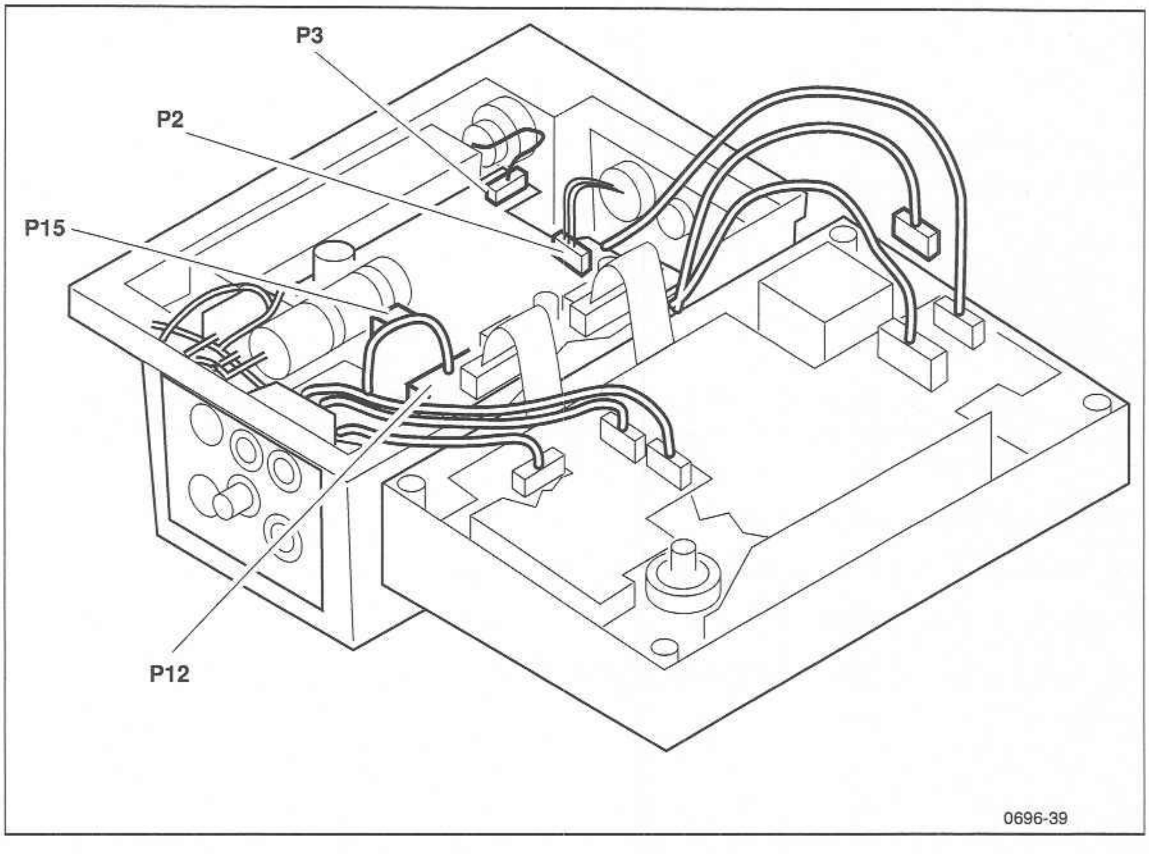
## Replacing the Recharger Board

The Recharger board is secured to the rear chassis by four screws. When removing the Recharger board, note the location of cables, plumbing, and screws and screw lengths.

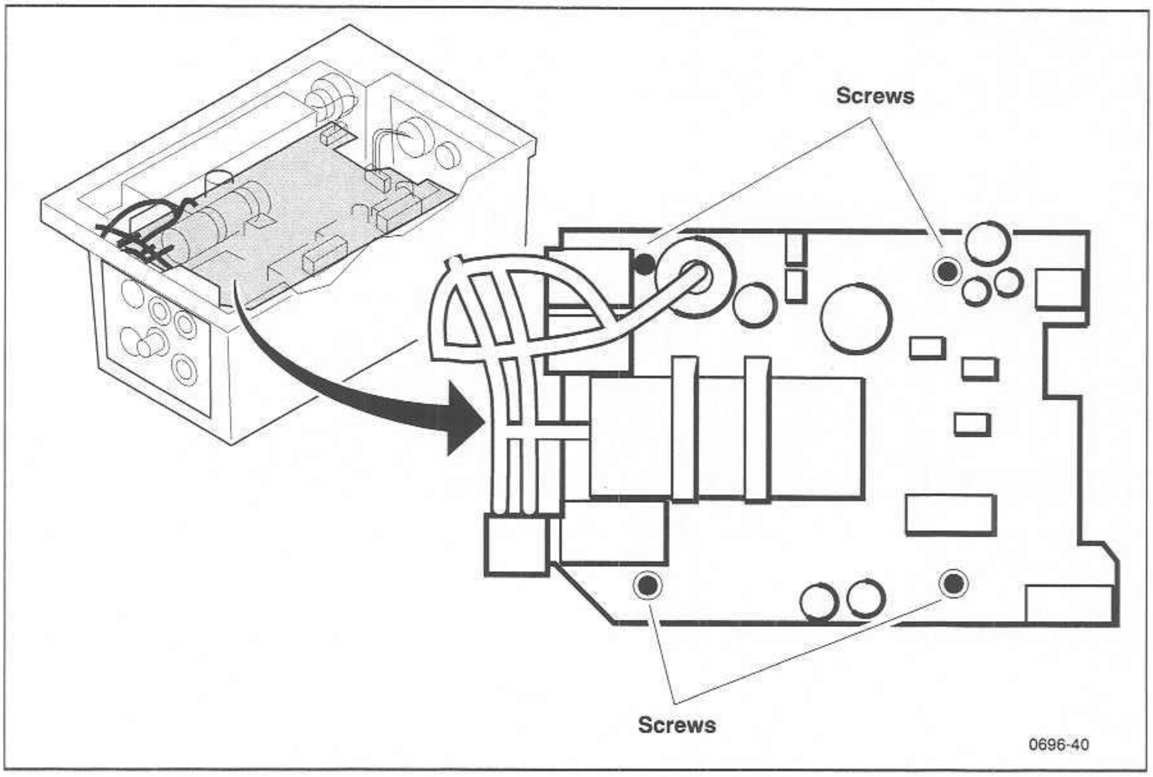
1. Remove the battery pack according to the procedures on page 71.
2. Open the monitor according to the procedure on page 75.
3. Disconnect the air tubing attached to the valves and pump at the junction indicated in the figure on on page 95.


DISCONNECT PLUMBING AT THIS POINT

4. Disconnect cables P2, P3, P12, and P14 from the Recharger board. Note cable routing for reinstallation.


P3
P2
P15
P12
0696-39

5. Remove the four screws securing the Recharger board to the rear chassis. Note the screw passing through the pressure transducer is longer than the three that pass through the board only.



6. Lift out the Recharger board.

**CAUTION**

**As you set the board in place during installation, keep the board clear of the power switch solder terminals to avoid binding against them. The terminals may become damaged if force is applied against them.**

When installing the Recharger board:

- blow out any dust and particulates using pressurized de-ionized gas
- move all cables out of the way
- torque screws to 3.8in-lbs to 4.2in-lbs (.43N-m to .47N-m)

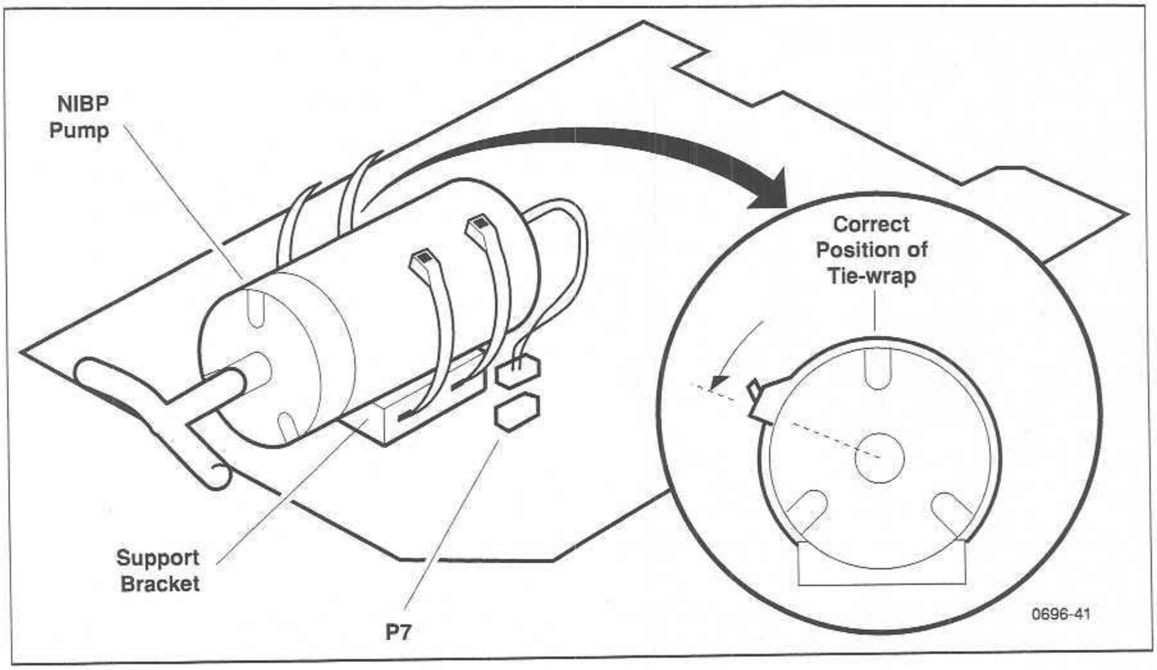
## Replacing the Pump

New wires and a connector are provided with the replacement pump kit.

1. Remove the battery pack according to the procedures on page 71.
2. Open the monitor according to the procedure on page 75.
3. Remove the Recharger board according to the procedure on page 94.
4. Unplug the pump cable from the Recharger board.
5. Disconnect the tubing from the pump.
6. Cut the tie wraps securing the pump to the Recharger board.
7. Lift the pump from the board, and remove the old tie wraps from the support brackets.

When installing a pump:

- Slide new tie wraps into support brackets as shown in the figure below.
- Set the pump onto the Recharger board.
- Secure the pump to the Recharger board with tie wraps, aligning the fastener ends as shown in the figure below and cutting off the excess.
- Plug in the pump cable to connector P7 on the Recharger board.



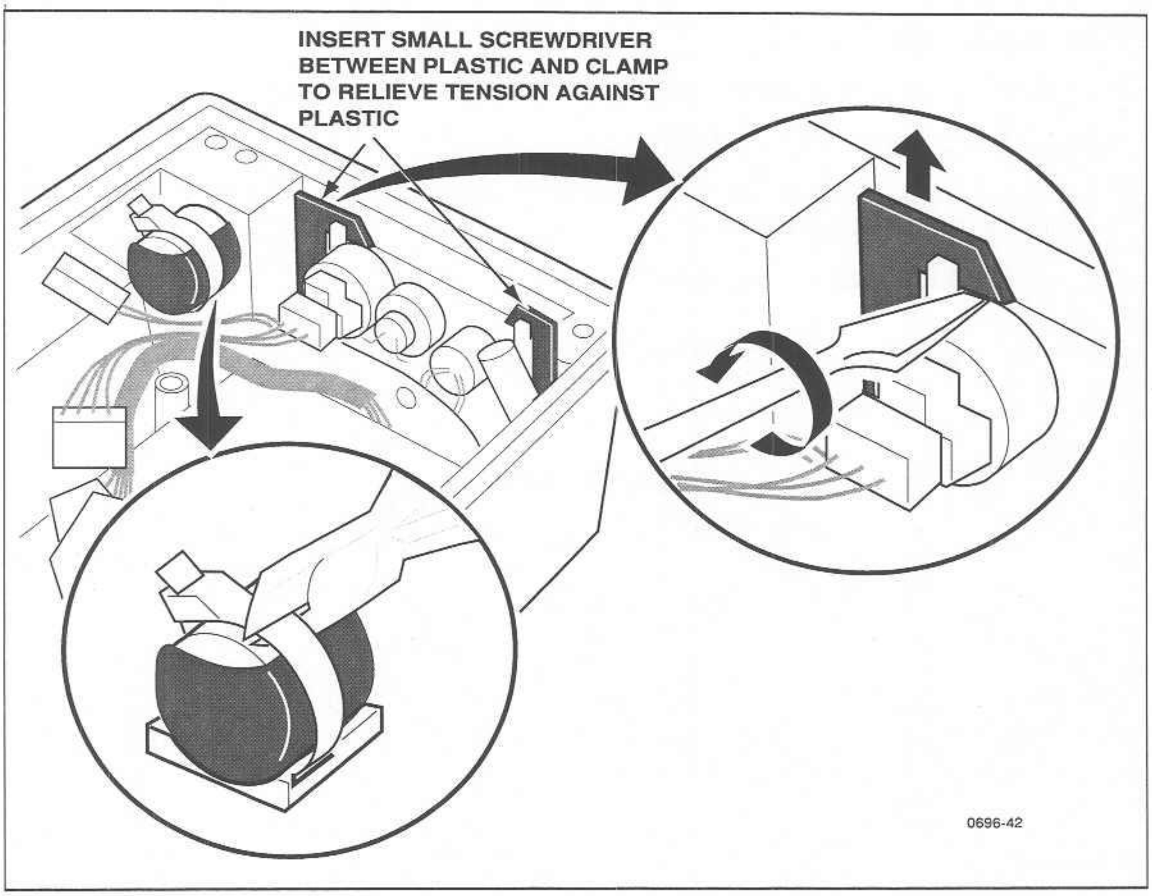
# Replacing the Side Panels

The Propaq Encore side panels are complete assemblies.

The side panels are sealed to the rear chassis with an adhesive gasket. A new gasket is provided with the new side panel kit.

## Removing the Right Side Panel

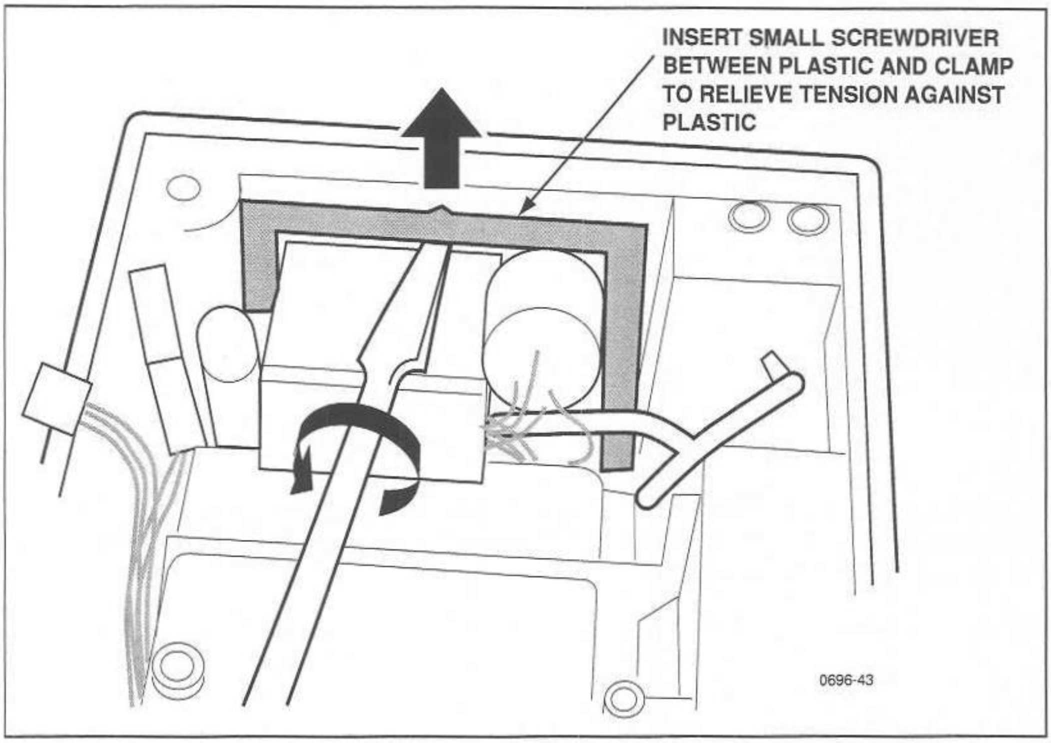
1. Remove the battery pack according to the procedures on page 71.
2. Open the monitor according to the procedure on page 75.
3. Remove the Recharger board according to the procedure on page 94.
4. Cut and remove the tie wrap securing the bead connected to the side panel.


INSERT SMALL SCREWDRIVER BETWEEN PLASTIC AND CLAMP TO RELIEVE TENSION AGAINST PLASTIC
0696-42

6. Remove the two right side panel clamps by inserting the end of the flat blade screwdriver under the clamp and gently rotating the blade to loosen the clamp. Then slide the clamp out.
7. Press the side panel out of the rear chassis. There is an adhesive gasket around the side panel which requires considerable force to separate. **Do not pry against components.**

## Removing the Left Side Panel

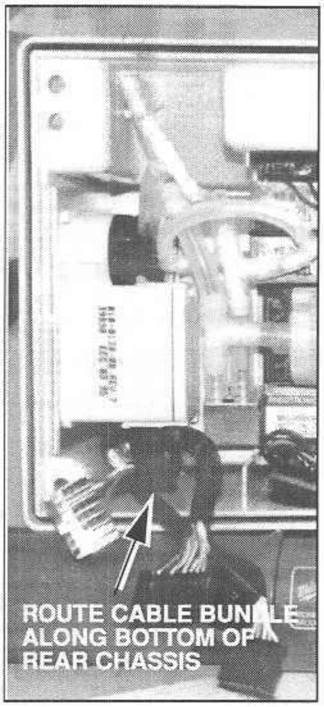
1. Remove the battery pack according to the procedures on page 71.
2. Open the monitor according to the procedure on page 75.
3. Remove the Recharger board according to the procedure on page 94.
4. Remove the U-shaped clamp that secures the left side panel assembly by inserting a small screwdriver between the clamp and plastic and the end of another flat blade screwdriver under the clamp and gently rotating the blade to loosen the clamp. Then slide the clamp out.


INSERT SMALL SCREWDRIVER BETWEEN PLASTIC AND CLAMP TO RELIEVE TENSION AGAINST PLASTIC
0696-43

5. Press the side panel out of the rear chassis. There is an adhesive gasket around the side panel which requires considerable force to separate. **Do not pry against components.**
6. Remove the tubing attached to the cuff hose connector. You can reuse this tubing when installing the new side panel.

## Installing Side Panels

1. Clean all gasket material from the rear chassis where the side panel is to be installed. (The adhesive side of duct tape can be used to pull away old gasket residue.)
2. Attach the tubing to the NIBP cuff hose connector.
3. Route the bundle of cabling with the bead under the temperature connector housing so that when the side panel is installed the connectors will extend out of the rear chassis along the bottom of the chassis. See the figure on on page 100.



note...

**Uncovering the protective paper in the next step exposes the adhesive on the gasket. Do not touch or otherwise contaminate the adhesive, or the adhesive may not properly seal the side panel.**

4. On the new side panel, remove the protective paper from the gasket attached to the side panel.

note...

**When installing the left side panel in the next step, slightly bend up wires at the P1 and P2 pressure connector pins to allow proper fit.**

5. Set the side panel in place.

   Make sure the side panel completely sets in place (it should be flush with the exterior of the rear chassis). If not properly fitted, the clamp securing the side panel will not seat.

6. Apply slight pressure to seal the side panel in the rear chassis.

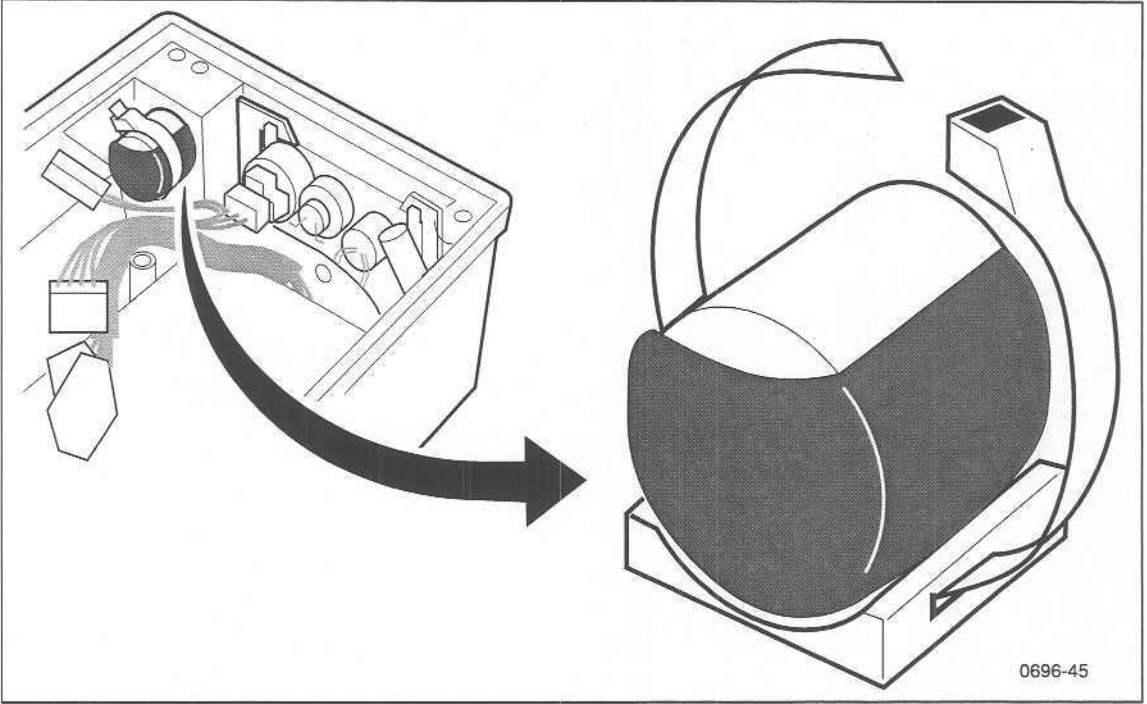
**CAUTION**

**Do not force the clamp in the next step. Forcing it may damage the side panel or rear chassis.**

7. Slide the clamp(s) in place with the detent facing the chassis plastic so that it presses against the chassis.

If the clamp requires excessive pressure to slide in place, remove the clamp and check the side panel to be sure it is completely seated.

8. Connect all plumbing and cables.
9. When installing the right side panel, install a new tie wrap to secure the bead to the rear chassis (see figure below).



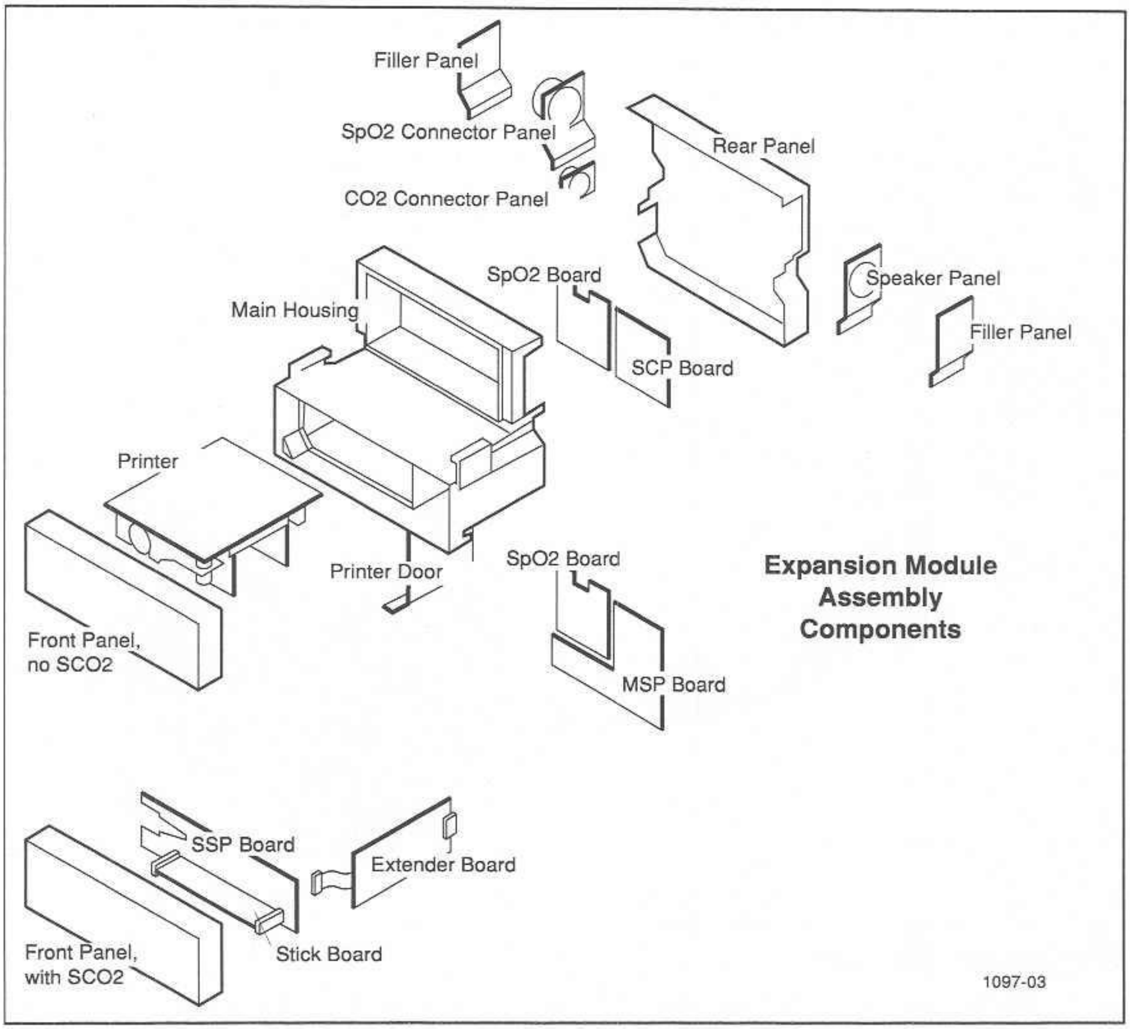
## Expansion Module

The expansion module housing contains one or all of the following (refer to figure on page 102):

- printer mechanism with printer main board
- MSP board (units with $CO_2$ option)
- $CO_2$ connector side panel
- SCP/$SpO_2$ board (units with printer and $SpO_2$ options)
- $SpO_2$ connector side panel
- $SpO_2$ speaker side panel
- front panel assembly with pushbuttons
- SSP board (units with sidestream $CO_2$)
- Stick board (units with sidestream $CO_2$)
- Extender board

note...

**For specific option configurations, refer to drawings beginning on page 123.**


Filler Panel
SpO2 Connector Panel
CO2 Connector Panel
Rear Panel
Speaker Panel
Filler Panel
SpO2 Board
Main Housing
SCP Board
Printer
Printer Door
SpO2 Board
Front Panel,
no SCO2
MSP Board
SSP Board
Extender Board
Front Panel,
with SCO2
Stick Board
1097-03

**Expansion Module Assembly Components**

*note...*

**The expansion module does not need to be separated from the monitor to replace the expansion module front panel.**

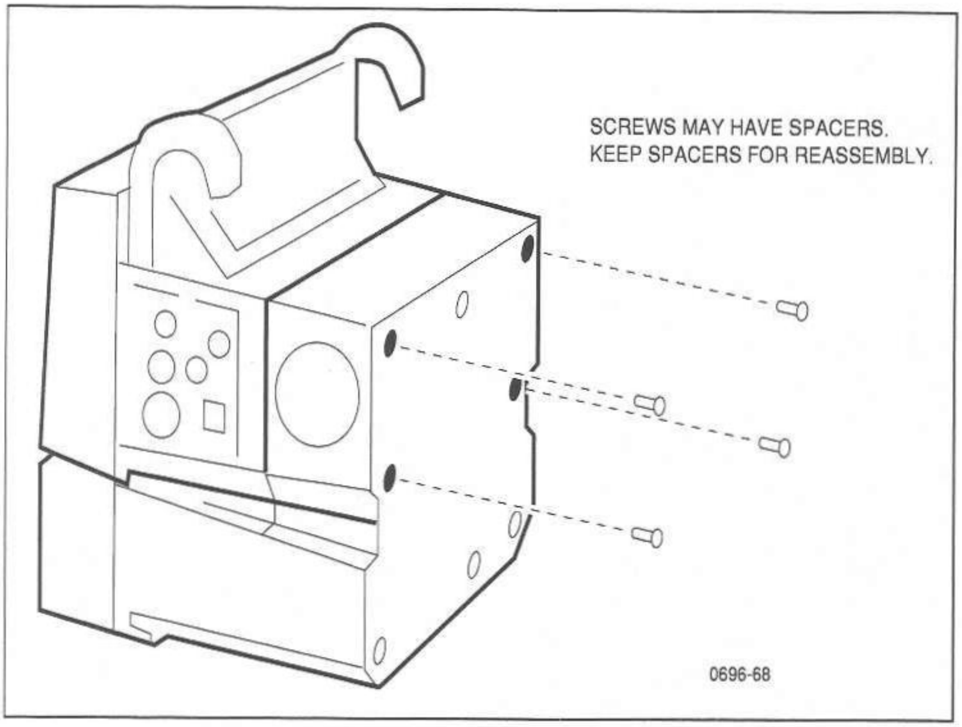
## Opening Expansion Module Rear Panel

1. Separate the monitor and expansion module according to the procedure **Removing the Dual Battery in Expansion Module** on page 73.

*note...*

**For all sidestream $CO_2$ options (226, 227, 228, or 229) remove the front panel and the extender board as instructed on page 104 and on page 116 before proceeding with the rear panel removal.**

2. Remove the four screws securing the rear panel to the expansion module chassis (see figure below).



CAUTION

**When disconnecting the expansion cable connector in the next step, note that it has two plastic securing clips that must be separated from the connector. These clips are fragile and should be handled carefully.**

3. Separate the rear panel from the chassis a few inches (keep any side panels with the rear), then disconnect the expansion cable connector and the printer cable connector from the circuit board (SCP or MSP board) in the rear panel.

4. Remove the rear panel with the side panels in place.

note...

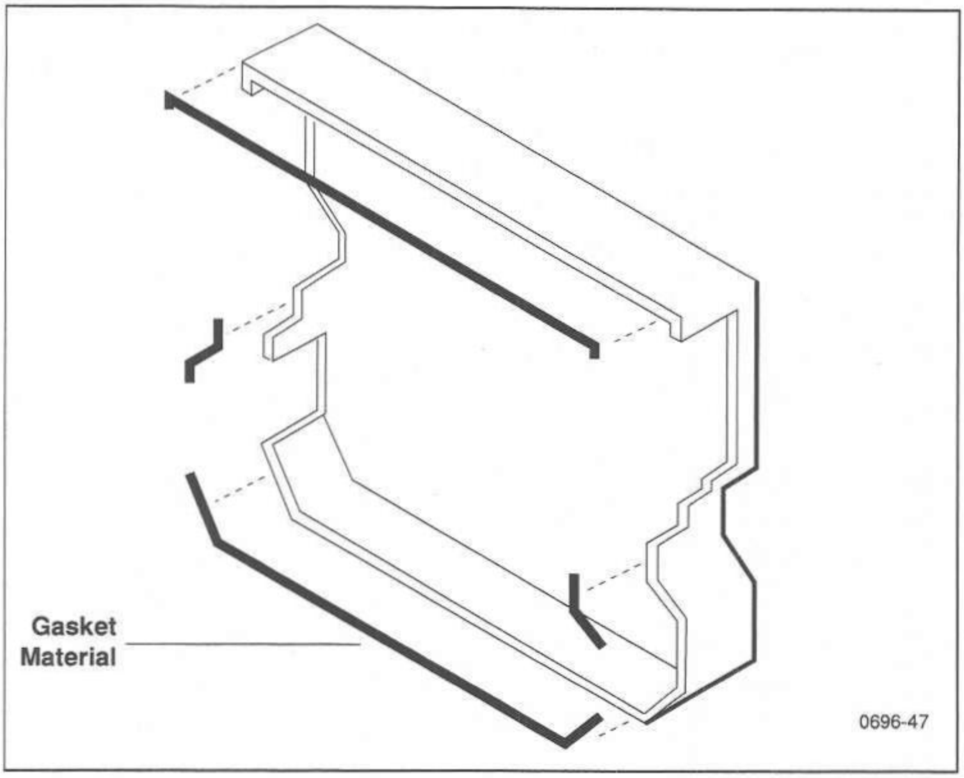
**The rear panel is sealed to the chassis with rubber gaskets around the perimeter of the rear panel. These gaskets can be reused when reassembling the expansion module. Save these gaskets. Also, spacers might not be secured to the rear panel and can fall out. As the unit is disassembled set aside the spacers for reuse during reassembly.**

## Closing Expansion Module

1. Make sure all cables are in place and the gaskets removed earlier are available.

2. Set the rubber gaskets in their proper places as shown in the figure below.

3. Connect the printer cable and expansion cable to the SCP or MSP board.



4. Set the chassis onto the rear panel, verifying that the gaskets don't slip out of a channel and become pinched between the rear panel and the chassis.

**CAUTION**

**To prevent damage to the expansion module chassis, make sure that the spacers are in place. The chassis may crack if screws are tightened without the spacers in place. Note that the 5 upper spacers are not used when the $SpO_2$ module is present.**

5. Torque screws to 4.75 in-lb to 5.25 in-lb (.54 N-m to .59 N-m).

## Replacing Expansion Module Front Panel

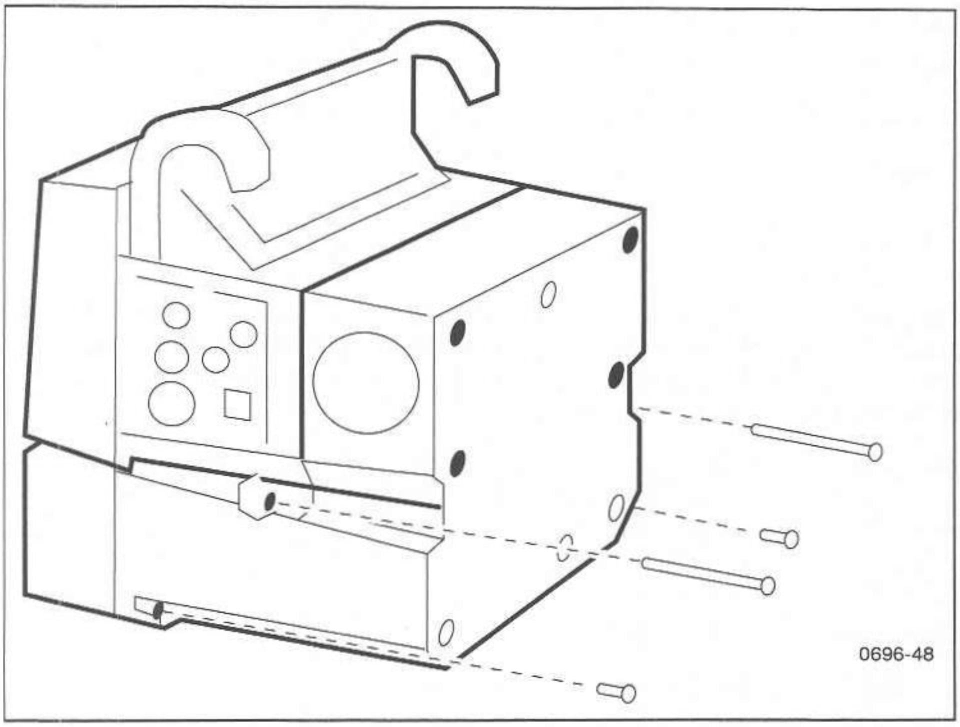
The front panel contains the printer buttons. Like the rear panel, the front is sealed to the chassis with a rubber O-ring gasket. This gasket can be re-used when replacing the front panel.

The expansion module front panel is attached to the chassis with four screws. Use the following procedure to remove the front panel:

1. Remove the four screws (see the figure below) holding the front panel.
2. For expansion module options with sidestream $CO_2$ (226, 227, 228, or 229), disconnect the cables from J1 and J3 on the SSP board.

note...

**To replace the sidestream $CO_2$ assemblies, refer to the procedures beginning on page 116.**



3. Separate the front panel from the chassis, disconnecting the front panel cable from the expansion module button board.

   A rubber O-ring gasket seals the front panel to the chassis. This gasket should be saved for re-installing on the front panel.

When installing the expansion module front panel:

- Verify the O-ring gasket is in place and not pinched.
- Torque screws to 6.65in-lbs to 7.35in-lbs (.75N-m to .83N-m)

## Replacing Expansion Module Button Board and Buttons

The expansion module contains a button board that has electrical contact areas to detect when an expansion module button is pressed. The front panel buttons are similar to the monitor buttons. A plastic button and flexible contact touches the contact area on the button board when a button is pressed.

Use the following procedure to remove the button board and buttons:

1. Remove the expansion module front panel according to the procedure on page 104.
2. Remove the two screws securing the button board to the front panel.
3. Remove the button board.

note...

**Do not touch the contact areas on the button board or the contact inside the flexible contacts. Touching these areas may deposit oil on them, reducing the ability of the parts to make electrical contact. If you touch these areas, clean them with a cotton swab moistened with isopropyl alcohol.**

4. To remove each button, gently lift out the rubber portion of the button contact attached to the inside of the front panel, then squeeze together the stem ends of the button from the inside of the front panel while gently pushing it out of the button channel. See the figure on page 89.

When installing the button board,

- make sure all buttons are completely installed
- make sure the rubber button contact is seated onto the channel
- torque screws to 4.75in-lbs to 5.2 in-lbs (.54N-m to .59N-m).

## Replacing the Printer

This section provides instructions on removing and installing the printer mechanism and printer main board. These two components are provided as a replacement unit called the printer assembly.

CAUTION

**Do not attempt to separate the printer mechanism from the printer main board. Replace these as a unit.**

### Removing Printer

Remove the printer assembly according to the following instructions.

1. Remove any printer paper.
2. Open the Expansion Module according to the procedure on page 102.
3. Remove the Expansion Module front panel according to the procedure on page 104.

4. Disconnect the front panel button cable from the front of the Printer Main board.

**CAUTION**

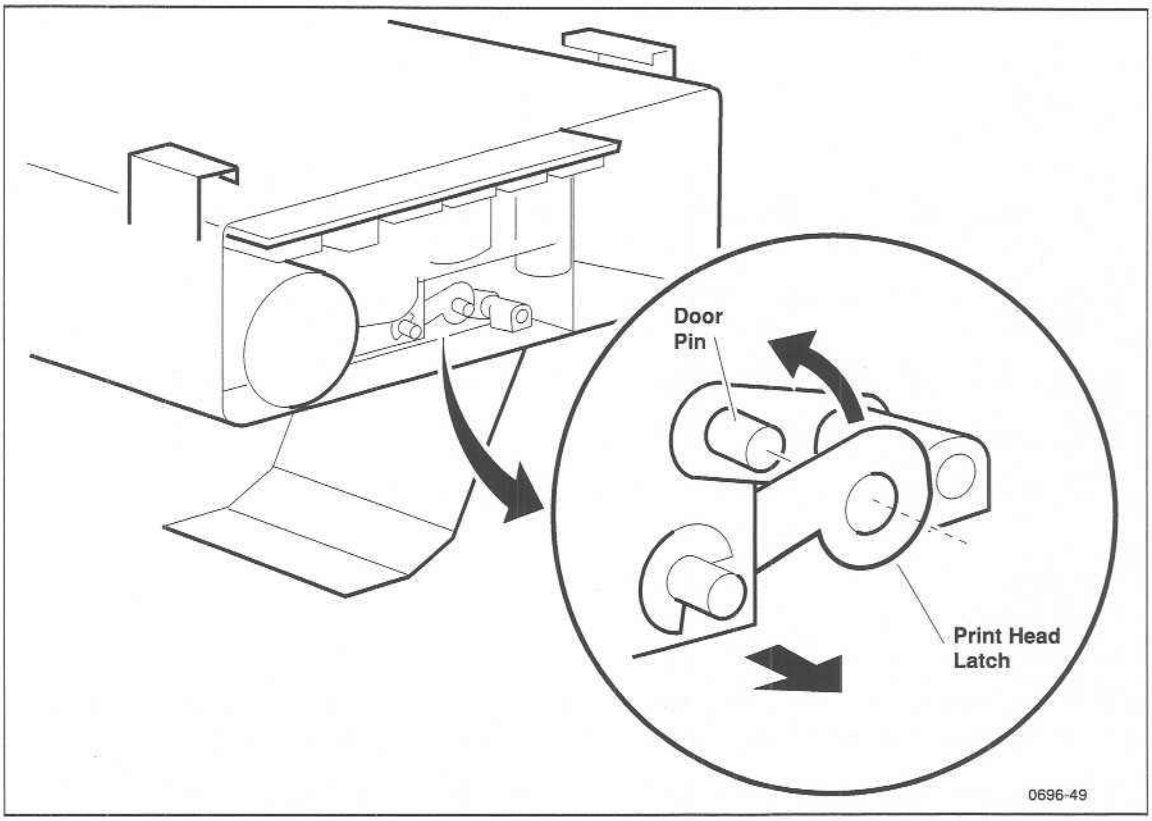
**When removing the shield in the next step, be careful not to tear it. The shield is held in place by double-sided adhesive pads.**

5. Carefully remove the plastic shield from the rear of the Expansion Module chassis. Set this shield aside.
6. Disconnect the battery cable and printer cable from the rear of the Printer Main board.
7. Lay the chassis on its back.
8. Completely open the paper door.

**CAUTION**

**As you remove the printer assembly from the chassis in the next step, rotate the printer door latch mechansim counter-clockwise to clear the chassis.**

9. Carefully slide the printer assembly out the front of the chassis. The printer assembly fits snugly, requiring some force to slide it out, and the door latch mechanism must be rotated counter-clockwise after it disengages from the printer door pin. See the figure on page 108.



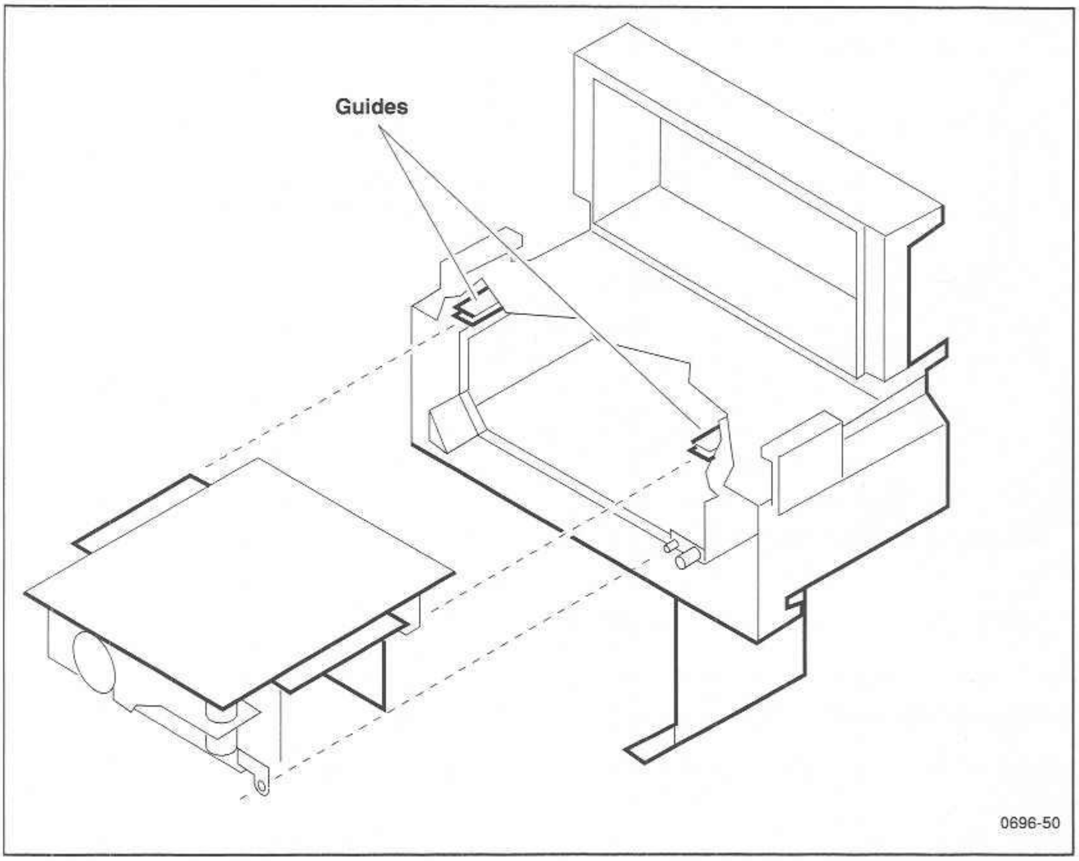
## Installing Printer

1. Lay the chassis on its back
2. Completely open the paper door.

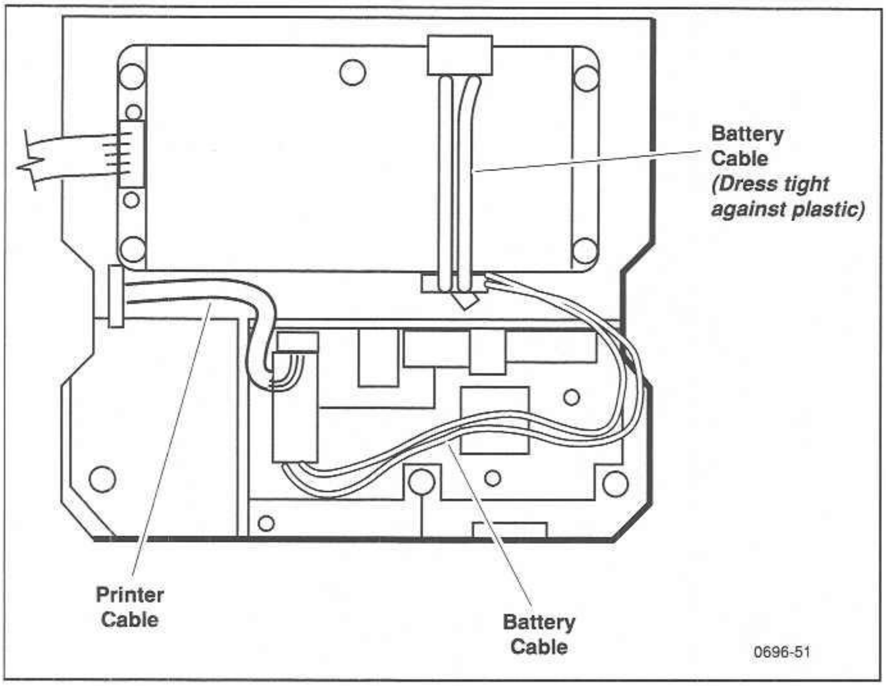
CAUTION

**As you install the printer assembly, rotate the printer door latch mechansim out of the way so it clears the chassis. The assembly fits snugly, but should not require much force to slide it in place.**

3. Slide the printer assembly into the guides as shown on page 109, making sure that after the door latch mechanism clears the chassis you rotate it clockwise to engage the printer door pin. See the figure above.



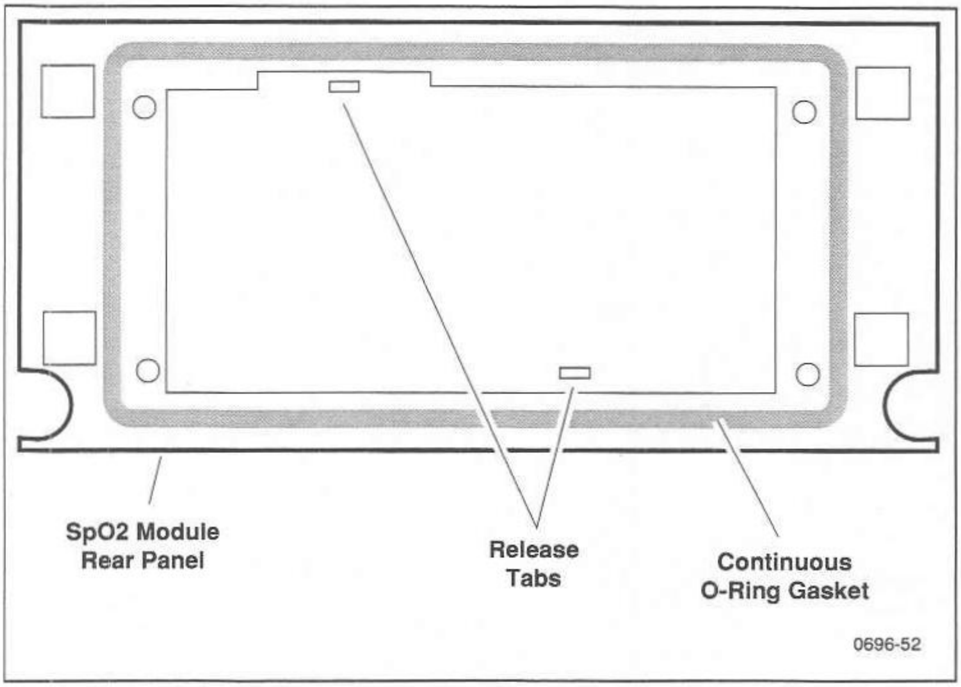
4. Carefully close and open the door a couple times to check that the door pin and latch mechanism function without binding.
5. Connect the battery cable and printer cable to the Printer Main board. It is important to properly dress the cables as shown on page 110.



6. Connect the button cable to the front of the Printer Main board.
7. Install the Expansion Module front panel, close the Expansion Module, and reattach it to the monitor.

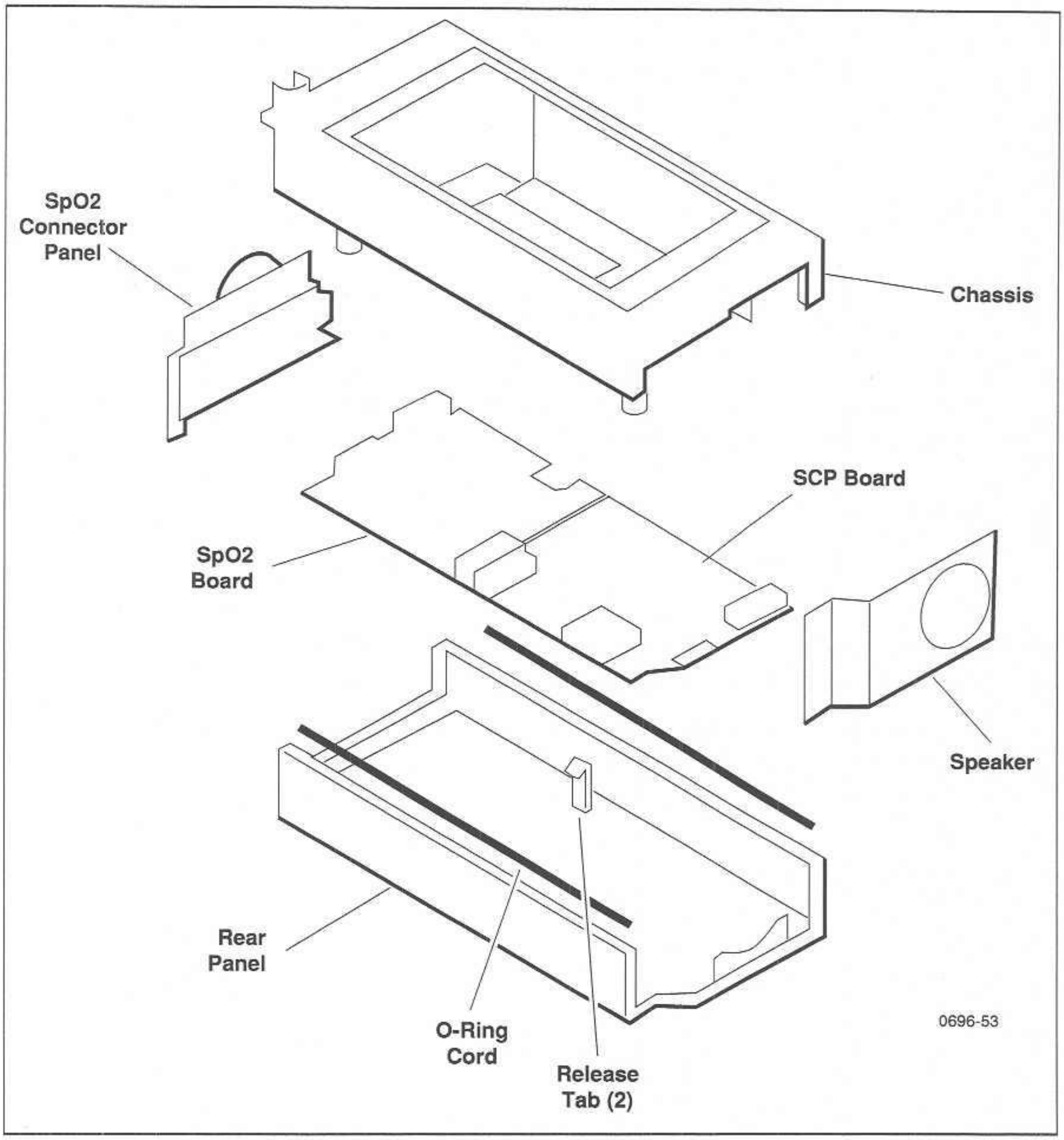
## Opening the $SpO_2$ Module

1. Separate the $SpO_2$ module from the monitor according to the procedure **Removing the Dual Battery in SpO2 Module** on page 75.
2. Two tabs secure the $SpO_2$ module rear panel to the $SpO_2$ module chassis. Using a small screwdriver or your finger, press on each of the tabs inside the $SpO_2$ module chassis while applying pressure to separate the rear panel from the chassis (see figure on on page 111). (When separating the rear panel from the chassis, make sure the side panels remain seated in the rear panel.)


SpO2 Module
Rear Panel
Release
Tabs
Continuous
O-Ring Gasket
0696-52

3. Once the tabs allow the rear panel to be removed, separate the rear panel from the chassis.

   The rear panel is sealed to the chassis with rubber O-ring gaskets. These gaskets can be reused when re-assembling the $SpO_2$ module.


SpO2 Connector Panel
Chassis
SCP Board
SpO2 Board
Speaker
Rear Panel
O-Ring Cord
Release Tab (2)
0696-53

When closing the SpO$_2$ module, verify no O-ring gasket slips out of its channel and becomes pinched between the rear panel and the chassis.

## Replacing the SpO$_2$ Circuit Boards

The following instructions describe how to replace the two SpO$_2$ circuit boards in the SpO$_2$ module and in the expansion module without a CO$_2$ option. Instructions for replacing SpO$_2$ boards in an expansion module with a CO$_2$ option are described in **Replacing the MSP/SpO$_2$ Circuit Boards** on page 114.

CAUTION

**When replacing the SpO$_2$ circuit boards, remove both circuit boards with the patient connector side panel still connected. Attempting to disconnect the patient connector side panel from the SpO$_2$ circuit board before removing both circuit boards with the side panel can damage the flex-cable between the side panel and the SpO$_2$ circuit board.**

1. Open the SpO$_2$ module or expansion module according to the procedures on page 110 and on page 102, respectively.

CAUTION

**In the next step, the connector securing clips are fragile and will break if not handled carefully.**

2. Disconnect the cable(s) from the SpO$_2$ SCP board by carefully releasing the securing clips and unplugging the connectors.
3. Disconnect the speaker cable from the SCP board.
4. Remove the speaker side panel from the chassis.
5. Remove the two screws securing the SCP board and SpO$_2$ board to the rear panel.
6. Lift out the two circuit boards and patient connector side panel as a unit. (The side panel easily slides out.)
7. Using equal pressure on both sides of the connector, disconnect the patient connector side panel connector from the SpO$_2$ circuit board.
8. Disconnect the two circuit boards by gently pulling them apart.

When installing the SpO$_2$ circuit boards first, plug the two circuit boards together. Then:

- Connect the patient connector side panel connector to the SpO$_2$ circuit board.
- Set the two circuit boards and side panels in place, making sure that the boards are seated on the support tabs.
- Torque screws to 4.75in-lbs to 5.25in-lbs (.54N-m to .59N-m).
- Reconnect the printer and expansion cables to the SCP board.

## Replacing the MSP/SpO$_2$ Circuit Boards

The following instructions describe how to replace the MSP / SpO$_2$ circuit boards in the expansion module with a CO$_2$ option. Instructions for replacing SpO$_2$ boards in SpO$_2$ module and expansion module without a CO$_2$ option installed are described in **Replacing the SpO2 Circuit Boards** on page 113

**CAUTION**

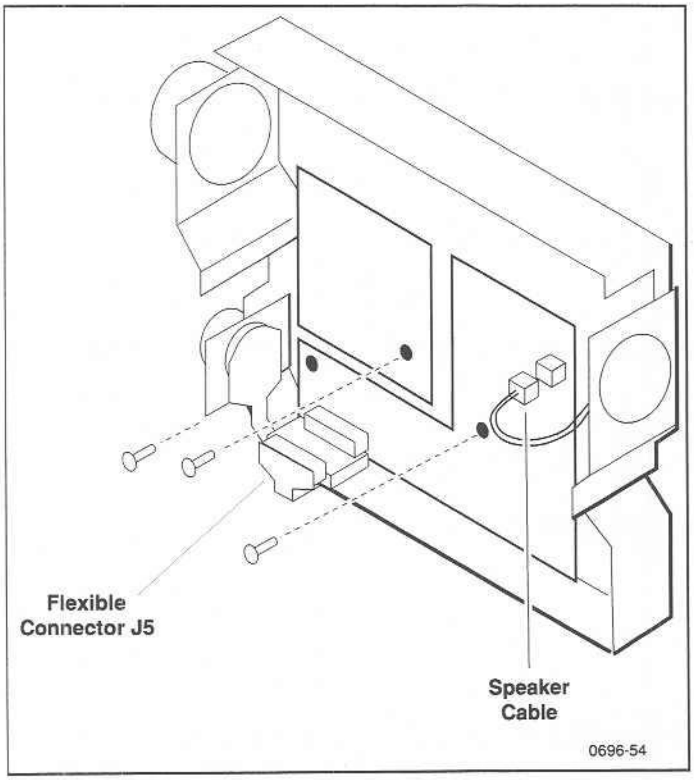
**When replacing the MSP/SpO$_2$ circuit boards, remove both circuit boards with the patient connector side panel still connected. Attempting to disconnect the patient connector side panel from the SpO$_2$ circuit board before removing both circuit boards with the side panel can damage the flex-cable between the side panel and the SpO$_2$ circuit board.**

1. Open the expansion module according to the procedure described on page 102.

**CAUTION**

**In the next step, the connector securing clips are fragile and will break if not handled carefully.**

2. Unplug the flex-cable connector J5 from the MSP board, but do not attempt to remove the mainstream $CO_2$ connector side panel.



3. Disconnect the speaker cable from the MSP board and remove the speaker side panel.
4. Remove the three screws securing the MSP board and $SpO_2$ board to the rear panel (see the figure above).
5. Lift out the two circuit boards and $SpO_2$ patient connector side panel as a unit. (The side panel easily slides out.)
6. Using equal pressure on both sides of the connector, disconnect the patient connector side panel connector from the $SpO_2$ circuit board.
7. Disconnect the two circuit boards by gently pulling them apart.

When installing the MSP/Sp$O_2$ circuit boards:

- plug the two circuit boards together
- connect the patient connector side panel connector to the Sp$O_2$ circuit board
- set the two circuit boards and side panels in place, making sure that the boards are seated on the support tabs
- torque screws to 4.75in-lbs to 5.25in-lbs (.54N-m to .59N-m)
- reconnect the mainstream $CO_2$ patient connector cable

## Replacing the Sidestream $CO_2$ Assemblies

The following instructions describe how to replace the sidestream $CO_2$ option assemblies in the expansion module. These include the sidestream processor (SSP) board, the sidestream $CO_2$ "Stick" board, and the extender board.

1. Loosen the expansion module front chassis according to the procedure on page 104.
2. Disconnect J1 and J3 from the SSP board to completely separate the front chassis.

### Replacing the extender board

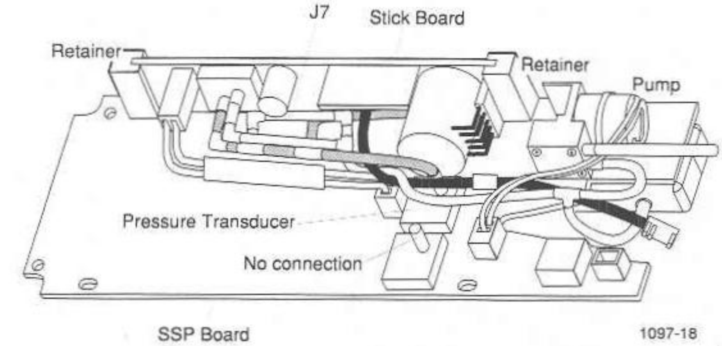
1. Remove the extender board from the MSP board through the left card slot in the expansion module.

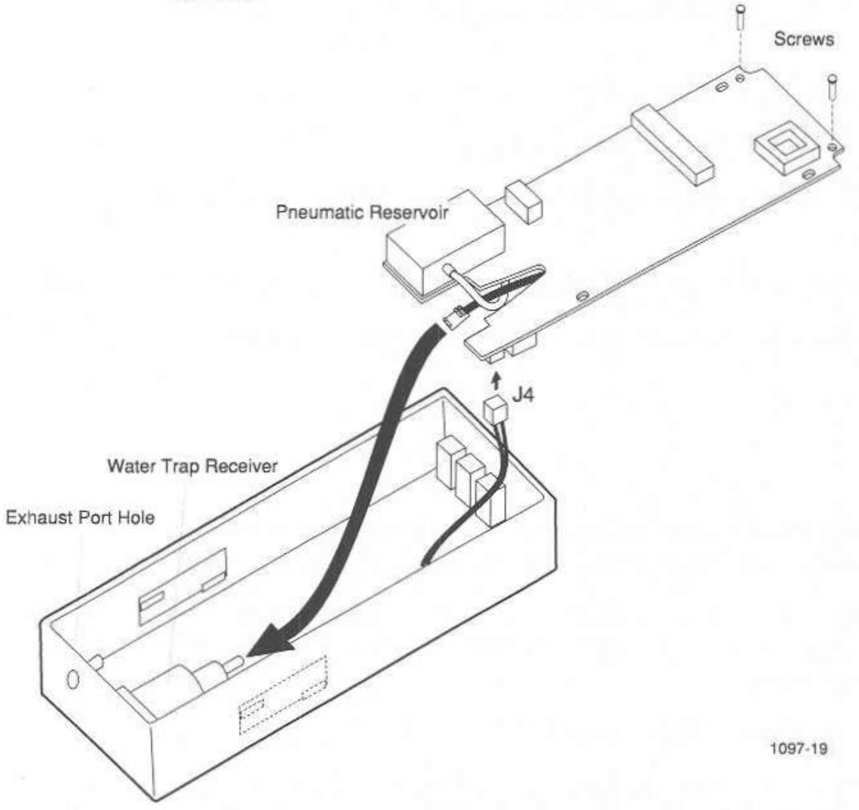
When reinstalling the extender board, observe P6 connector mating while installing through the left card slot to ensure proper connection with the MSP board.

### Removing the SSP/Stick board assembly:

CAUTION

**When servicing the SSP and Stick board assemblies, be sure to note the tubing routing prior to disconnection. Always reassemble tubing exactly as removed.**


J7
Stick Board
Retainer
Retainer
Pump
Pressure Transducer
No connection
SSP Board
1097-18


Screws
Pneumatic Reservoir
J4
Water Trap Receiver
Exhaust Port Hole
1097-19

1. Remove the two screws located on the right edge of the SSP board (as viewed from the front).
2. Tilt the loosened right edge of the SSP board assembly (with interconnected Stick board) up, away from the mounting screw posts far enough to allow access to the tubing connections under the board.
3. Disconnect the tubing from the water trap receiver and exhaust port using rounded, non-serrated pliers only. Disconnect the water trap switch connector from J4.
4. Lift the SSP/Stick assembly up and out of the front chassis plastic, clearing all board components from the retaining tabs on the insides of the front chassis plastic as the assembly is removed.

## Removing the Stick board from the SSP board:

1. Disconnect the tubing from the pump and pressure transducer PT2 on the front-facing side of the SSP board and the pneumatic reservoir on the rear-facing side.

2. Remove the two screws from the front-facing side of the SSP board that secure two slotted nylon Stick board retainers.
3. Pull the Stick board up to free it from connector J7 and remove it from the SSP board. For Stick board replacement purposes, leave all tubing as removed connected to the Stick board.

When reconnecting the Stick and SSP boards:

- reconnect the two boards (connector J7)
- install retainers onto Stick board
- install screws into retainers to secure the Stick board (torque to 2.5 in/lbs.)
- reconnect tubing to the pump, transducer PT2, and the pneumatic reservoir (route tubing exactly as removed)

When reinstalling the SSP/Stick assembly into the front panel:

- reconnect water trap switch to J4 on the SSP board
- from a vertical position, insert left edge of SSP board into retaining tabs on the inside of the front panel plastic
- align tubing as originally configured to allow access for connections and to prevent pinching
- connect tubing to the water trap, using rounded, non-serrated pliers only

**WARNING**

**Failure to connect the exhaust post tubing may allow concentration of oxygen inside of the monitor and create a potential explosion risk.**

- lower the right side of the SSP/Stick assembly and slide the left side into the retaining tabs to properly seat the boards into the front panel assembly (check all tubing and cable routing to ensure that none are pinched.
- connect exhaust port tubing, using rounded, non-serrated pliers only
- secure screws through SSP board to front panel (torque to 5.0 in/lbs.)

When reinstalling the front panel on the expansion module:

- connect J1 and J3 to the SSP board
- route printer cable in front of printer motor
- fit front panel to the main expansion module chassis
- secure front panel with four screws (torque to 3.5 in/lbs.)

**WARNING**

**To ensure that all tubing is properly connected after servicing SCO$_2$, perform the sidestream functional test in Section 2 when complete.**

## Replacing Expansion Module Side Panels

The side panels easily slide out once the chassis and rear panel are separated. If the patient connector side panel is being replaced, this side panel and the two circuit boards must be removed together before disconnecting the side panel from the circuit board. **Refer to Replacing the $SpO_2$ Circuit Boards** or **Replacing the MSP/$SpO_2$ Circuit Boards** earlier.

If the speaker side panel is being replaced, separate the chassis and rear panel as described earlier in this section, disconnect the speaker from the SCP or MSP board, and slide out the speaker side panel.

# Section 6
# Technical Overview

This section describes the electronics of the Encore monitor and three of its options: Printer, Pulse Oximetry ($SpO_2$), and Capnography ($CO_2$).

This section is intended as an aid to servicing at the field replaceable unit level and contains only system-level and functional-level circuit descriptions.

When replacing modules or components, refer to Section 5, Repair Procedures. Parts numbers for replaceable parts are located in Section 7.

## System Description

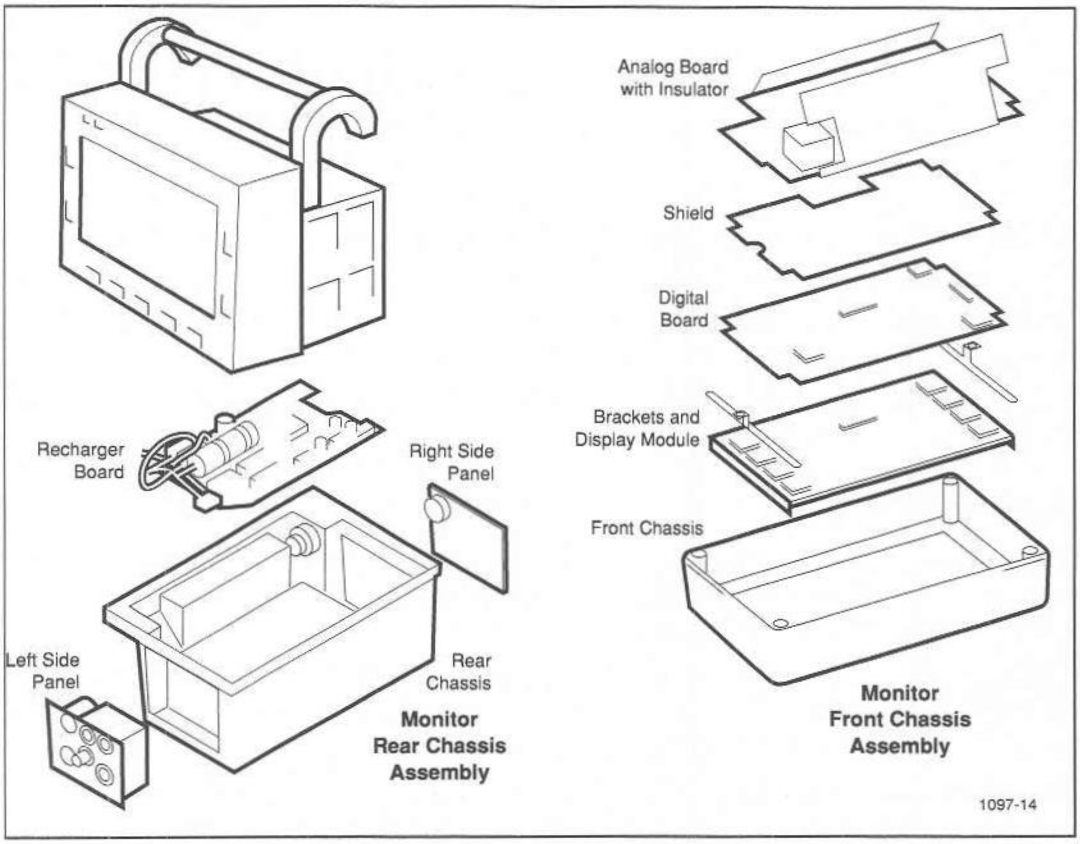
The Encore monitor can be configured as a stand-alone monitor or with one of two optional housings containing different monitoring and printer options. The figure on on page 122 illustrates the possible housing configurations.

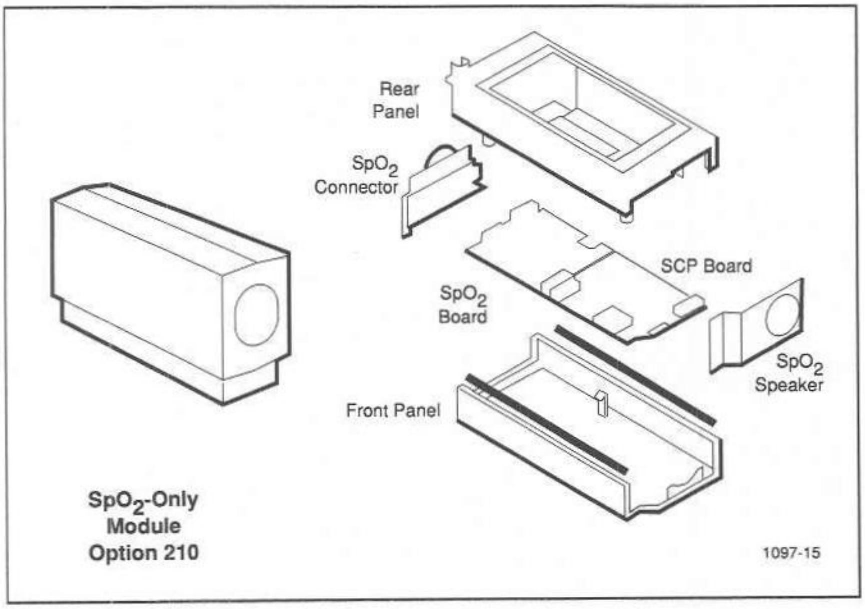
The main functional modules (e.g. Analog Board, Recharger Board, Printer, SCP Board, etc.) reside in the housings. The figures on the following pages illustrate the location of the main functional modules in the Propaq Encore monitoring system housings.

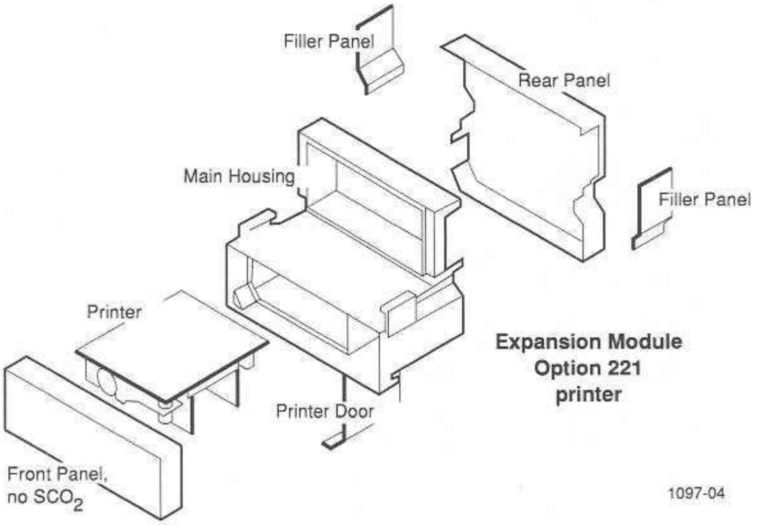
The Encore *monitor* electronics reside on three circuit boards within the monitor housing (front and rear chassis). Additional circuitry for the *printer* and *optional monitoring parameters* reside on additional circuit boards housed in the expansion modules.

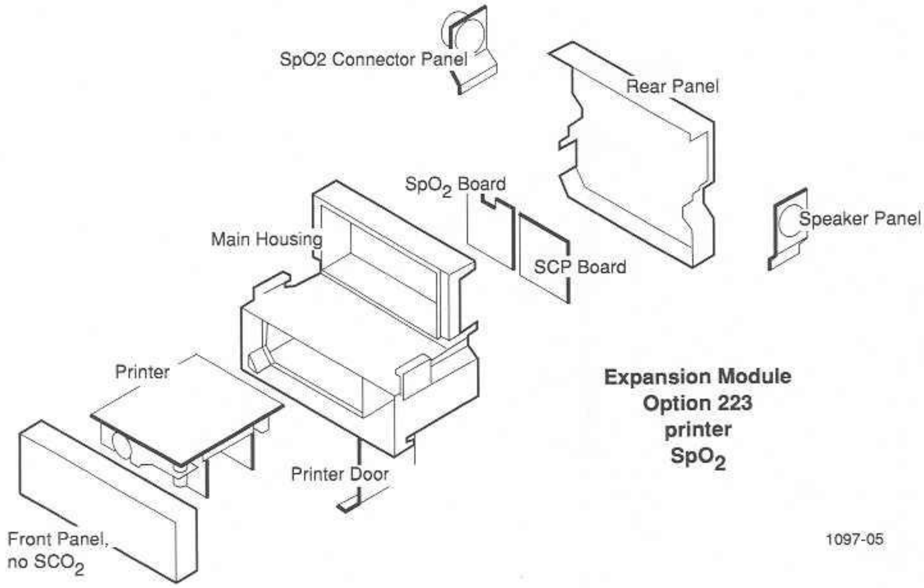
The Encore system block diagram is shown on on page 127.

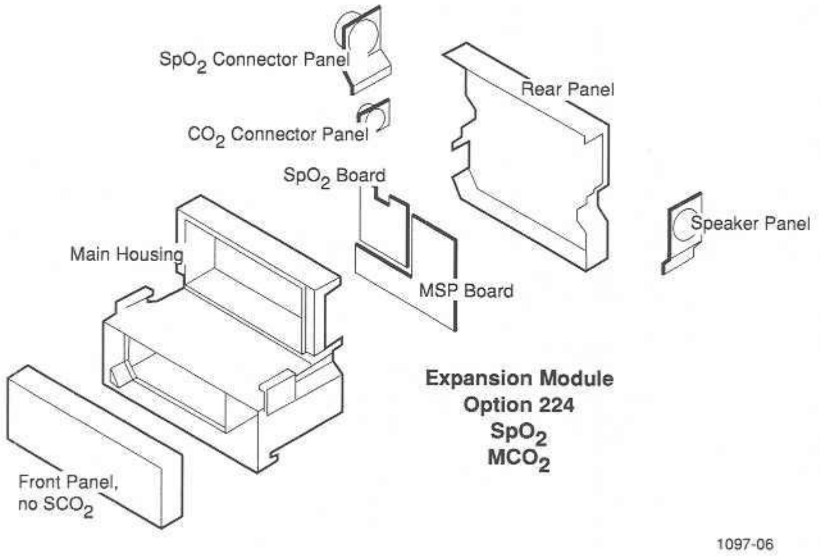
The Encore electronics consist of the power system, monitoring electronics, and the cuff pneumatics.

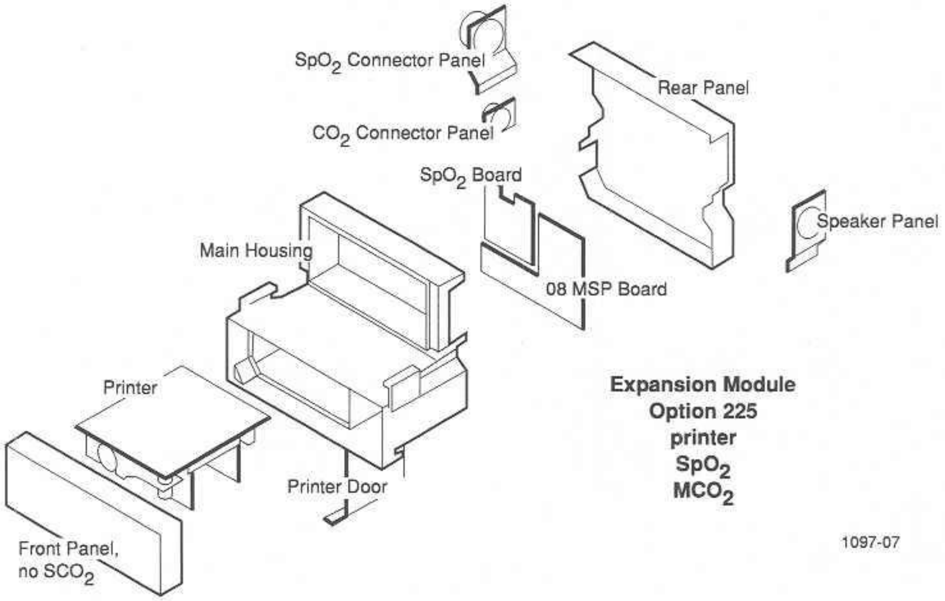

Recharger Board
Right Side Panel
Left Side Panel
Rear Chassis
Monitor Rear Chassis Assembly
Analog Board with Insulator
Shield
Digital Board
Brackets and Display Module
Front Chassis
Monitor Front Chassis Assembly
1097-14

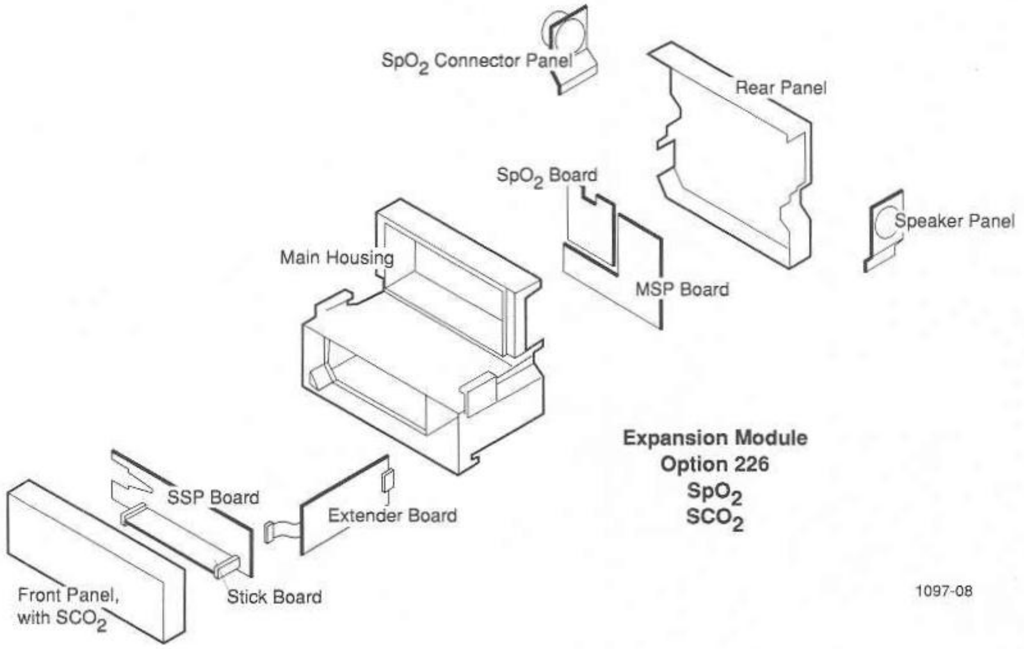

Rear Panel
SpO2 Connector
SCP Board
SpO2 Board
SpO2 Speaker
Front Panel
SpO2-Only Module Option 210
1097-15

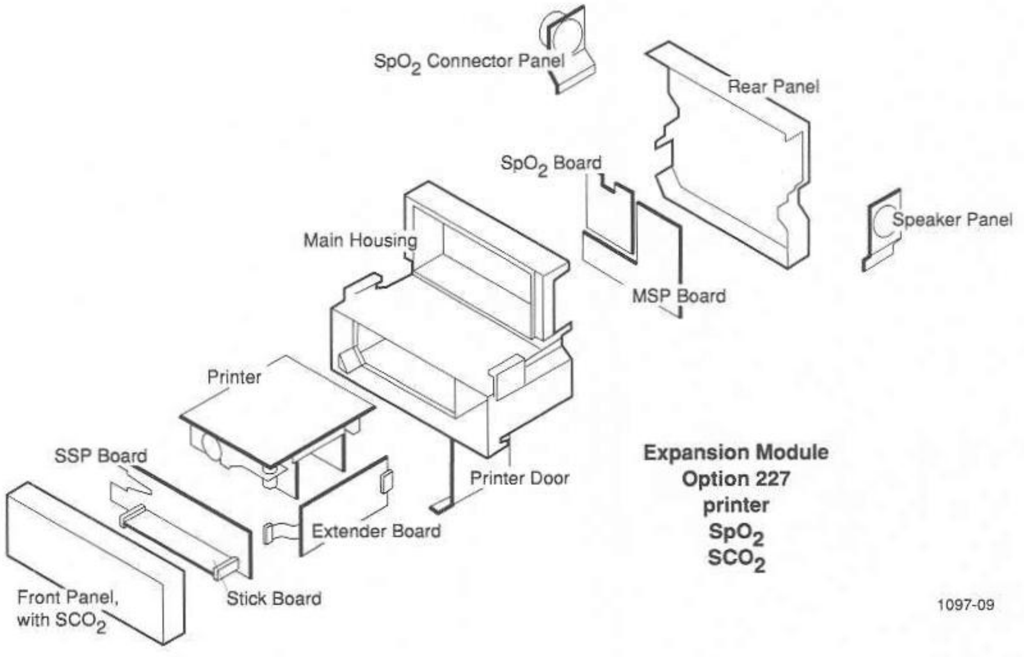

Filler Panel
Rear Panel
Main Housing
Filler Panel
Printer
Expansion Module
Option 221
printer
Printer Door
Front Panel,
no $SCO_2$
1097-04

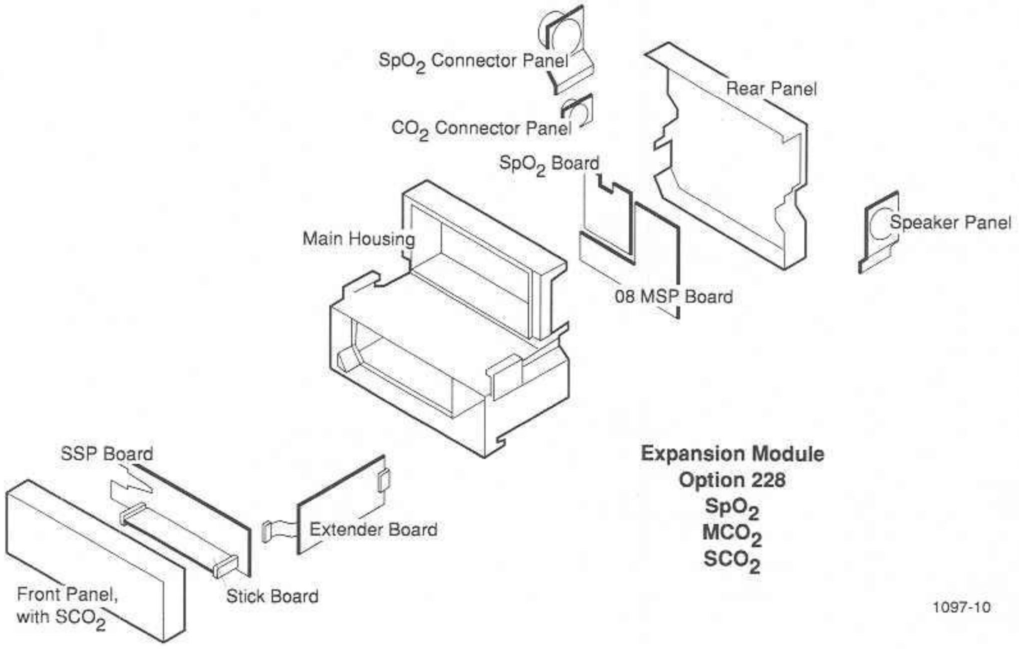

SpO2 Connector Panel
Rear Panel
$SpO_2$ Board
Speaker Panel
Main Housing
SCP Board
Printer
Expansion Module
Option 223
printer
$SpO_2$
Printer Door
Front Panel,
no $SCO_2$
1097-05

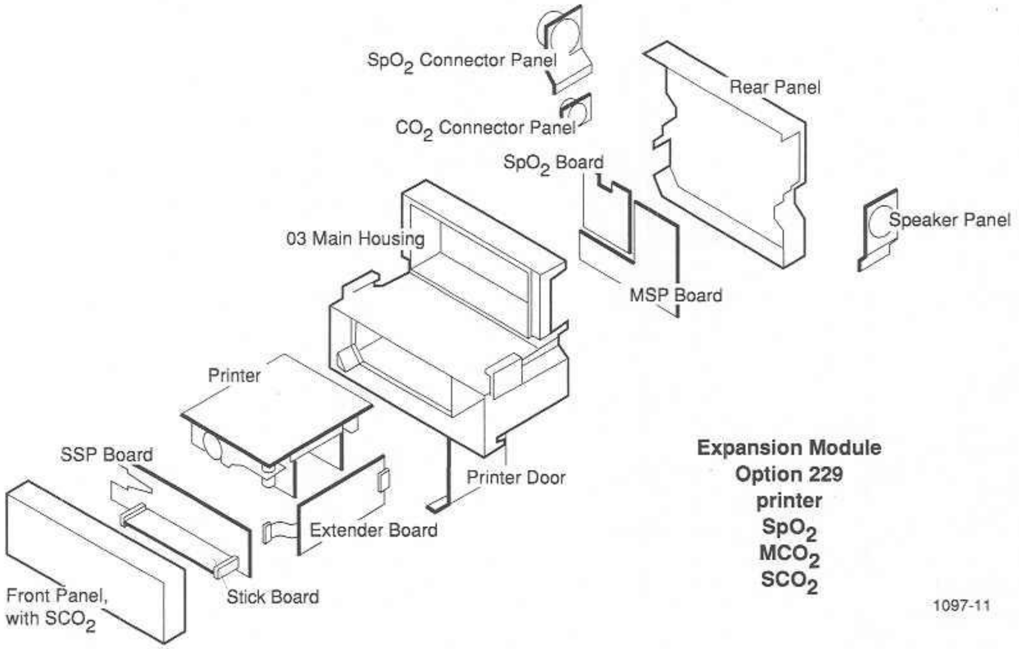

SpO₂ Connector Panel
CO₂ Connector Panel
SpO₂ Board
Rear Panel
Speaker Panel
Main Housing
MSP Board
Expansion Module
Option 224
SpO₂
MCO₂
Front Panel,
no SCO₂
1097-06

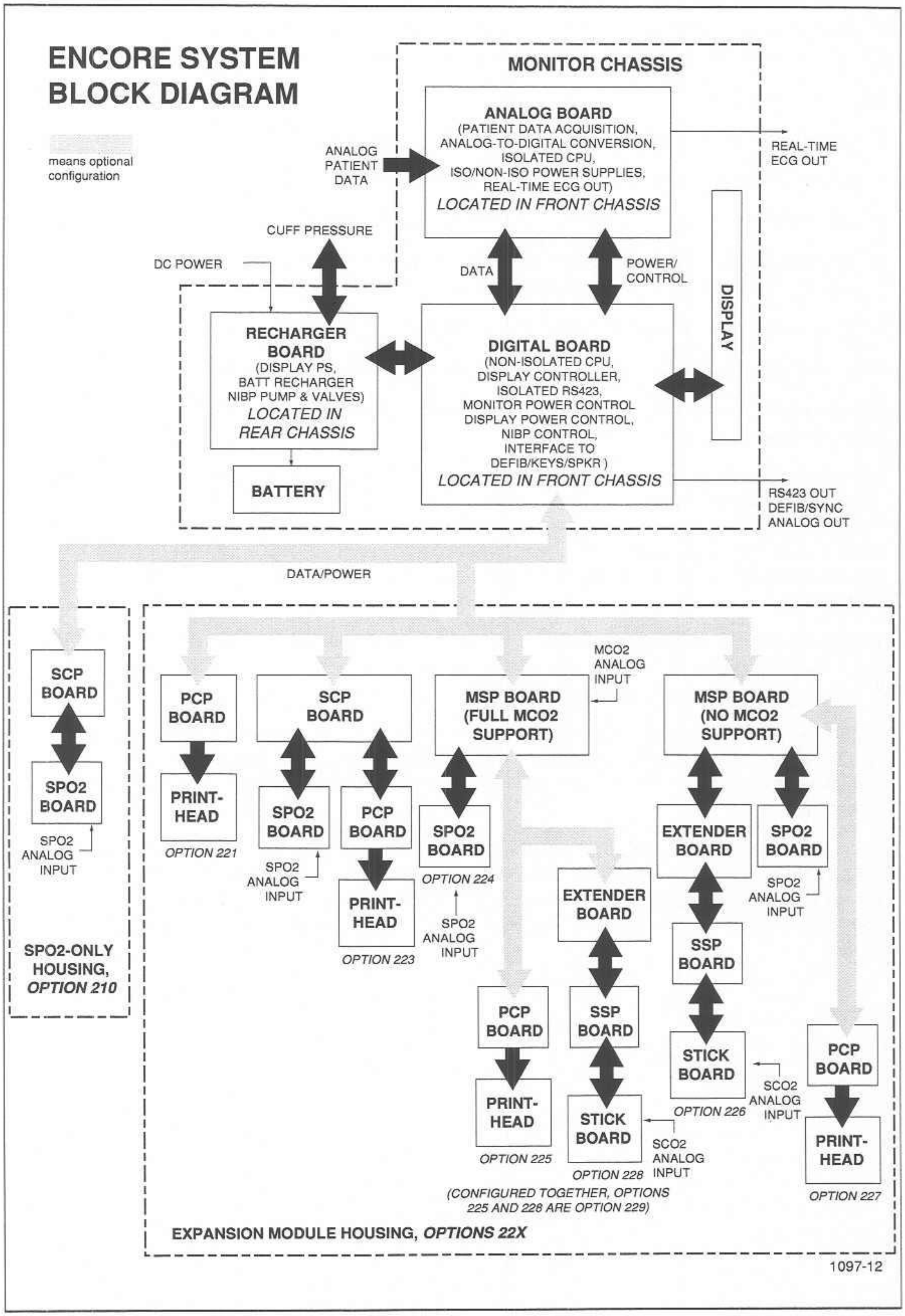

SpO₂ Connector Panel
CO₂ Connector Panel
SpO₂ Board
Rear Panel
Speaker Panel
Main Housing
08 MSP Board
Printer
Printer Door
Expansion Module
Option 225
printer
SpO₂
MCO₂
Front Panel,
no SCO₂
1097-07


SpO$_2$ Connector Panel
Rear Panel
SpO$_2$ Board
Speaker Panel
Main Housing
MSP Board
Expansion Module
Option 226
SpO$_2$
SCO$_2$
SSP Board
Extender Board
Front Panel,
with SCO$_2$
Stick Board
1097-08


SpO$_2$ Connector Panel
Rear Panel
SpO$_2$ Board
Speaker Panel
Main Housing
MSP Board
Printer
SSP Board
Printer Door
Expansion Module
Option 227
printer
SpO$_2$
SCO$_2$
Extender Board
Front Panel,
with SCO$_2$
Stick Board
1097-09


$SpO_2$ Connector Panel
Rear Panel
$CO_2$ Connector Panel
$SpO_2$ Board
Speaker Panel
Main Housing
08 MSP Board
SSP Board
Extender Board
Front Panel, with $SCO_2$
Stick Board
Expansion Module
Option 228
$SpO_2$
$MCO_2$
$SCO_2$
1097-10


$SpO_2$ Connector Panel
Rear Panel
$CO_2$ Connector Panel
$SpO_2$ Board
Speaker Panel
03 Main Housing
MSP Board
Printer
SSP Board
Printer Door
Extender Board
Front Panel, with $SCO_2$
Stick Board
Expansion Module
Option 229
printer
$SpO_2$
$MCO_2$
$SCO_2$
1097-11


ENCORE SYSTEM BLOCK DIAGRAM
means optional configuration
MONITOR CHASSIS
ANALOG BOARD
(PATIENT DATA ACQUISITION, ANALOG-TO-DIGITAL CONVERSION, ISOLATED CPU, ISO/NON-ISO POWER SUPPLIES, REAL-TIME ECG OUT)
LOCATED IN FRONT CHASSIS
ANALOG PATIENT DATA
REAL-TIME ECG OUT
CUFF PRESSURE
DC POWER
DATA
POWER/ CONTROL
DISPLAY
RECHARGER BOARD
(DISPLAY PS, BATT RECHARGER NIBP PUMP & VALVES)
LOCATED IN REAR CHASSIS
BATTERY
DIGITAL BOARD
(NON-ISOLATED CPU, DISPLAY CONTROLLER, ISOLATED RS423, MONITOR POWER CONTROL DISPLAY POWER CONTROL, NIBP CONTROL, INTERFACE TO DEFIB/KEYS/SPKR )
LOCATED IN FRONT CHASSIS
RS423 OUT DEFIB/SYNC ANALOG OUT
DATA/POWER
SCP BOARD
SPO2 BOARD
SPO2 ANALOG INPUT
SPO2-ONLY HOUSING, OPTION 210
PCP BOARD
PRINT-HEAD
OPTION 221
SCP BOARD
SPO2 BOARD
SPO2 ANALOG INPUT
PCP BOARD
PRINT-HEAD
OPTION 223
MSP BOARD (FULL MCO2 SUPPORT)
MCO2 ANALOG INPUT
SPO2 BOARD
OPTION 224
SPO2 ANALOG INPUT
EXTENDER BOARD
PCP BOARD
PRINT-HEAD
OPTION 225
SSP BOARD
STICK BOARD
SCO2 ANALOG INPUT
OPTION 228
(CONFIGURED TOGETHER, OPTIONS 225 AND 228 ARE OPTION 229)
MSP BOARD (NO MCO2 SUPPORT)
EXTENDER BOARD
SPO2 BOARD
SPO2 ANALOG INPUT
SSP BOARD
STICK BOARD
SCO2 ANALOG INPUT
OPTION 226
PCP BOARD
PRINT-HEAD
OPTION 227
EXPANSION MODULE HOUSING, OPTIONS 22X
1097-12

## Power Electronics Description

The power system circuits are located on the Analog, Digital, and Recharger boards. The power system includes the ac mains power adapter. Refer to the figure on on page 129.

The power system

- converts ac mains current to dc current (external power adapter)
- recharges the internal battery pack (Recharger board)
- converts battery power to several voltages for the display (Recharger board)
- converts battery power to several regulated and unregulated power supplies for both isolated and non-isolated electronics (Analog board)
- provides isolated power for RS423 communications (Digital board)
- controls the activation and deactivation of the power system (Digital board)

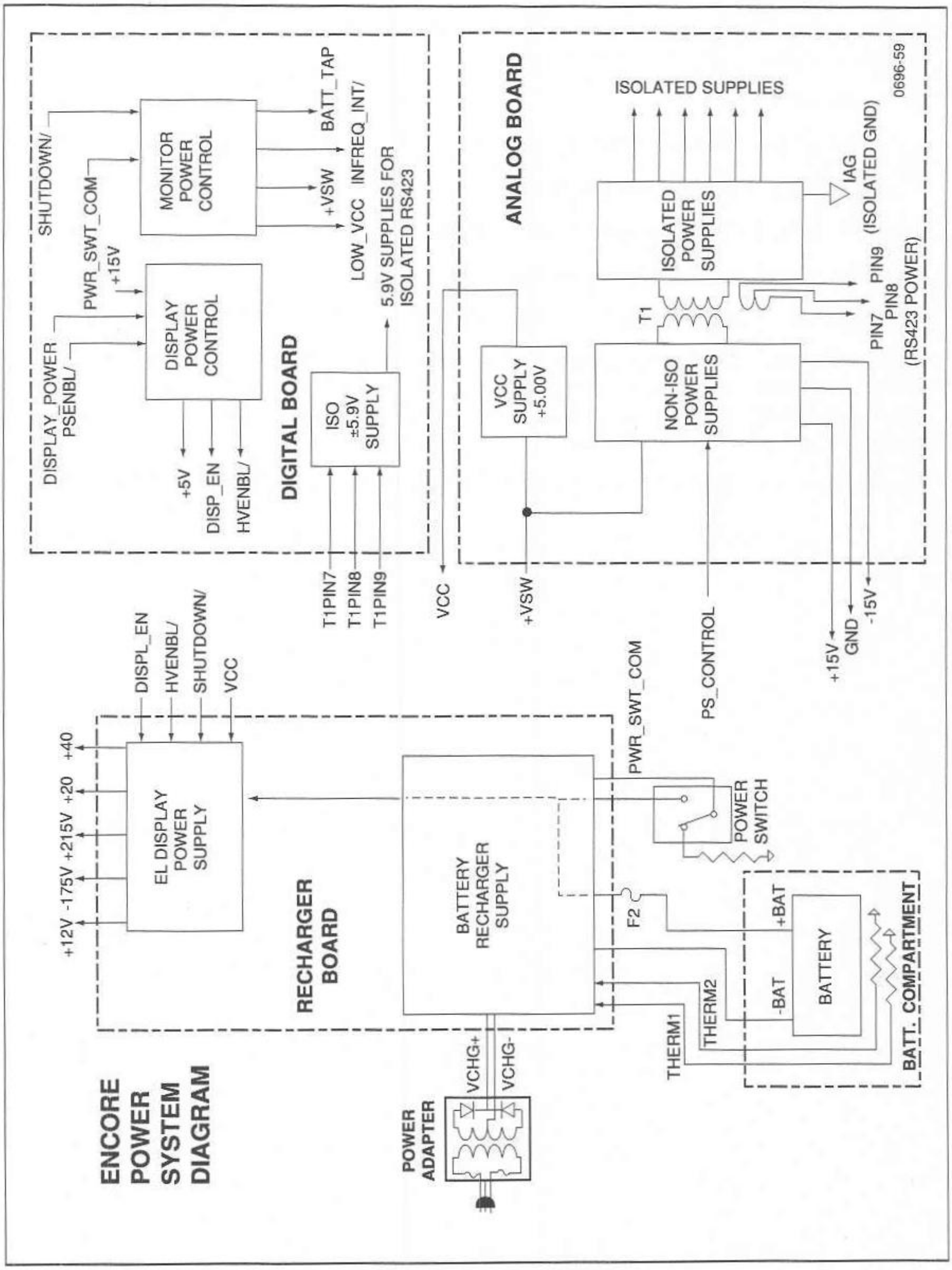
Power is delivered from ac mains to the monitor through a power adapter. The adapter converts ac to dc current at approximately 15 Volts.

The internal battery continually supplies monitor power and is recharged while the power adapter is plugged into ac mains and connected to the monitor. The monitor can also be recharged from any dc power source that meets the monitor's dc power input specifications. An accessory cable is available from Protocol Systems to allow connection of such a power source to the dc power input connector on the monitor's right side panel. This cable must be used for monitor calibration.

Thermistors in the battery compartment monitor battery temperature. As battery charging takes place, battery temperature rises. The recharger output voltage is temperature-compensated; as battery temperature rises, maximum recharger output voltage decreases.

Switching power supplies generate power for recharging the battery, for powering the display, and for other power sources throughout the monitor. Suppression devices designed into the power system provide EMI suppression. A transformer bridges the battery power to the isolated electronics.

Several control lines activate and deactivate the power supplies. These control lines originate on the Digital board and are routed to the Recharger board and Analog board to activate the display power supply and the main power supply. The recharger supply is automatically activated any time an adequate dc power source is connected to the power input jack on the monitor's right side panel.


ENCORE POWER SYSTEM DIAGRAM
DIGITAL BOARD
DISPLAY_POWER
PSENBL/
PWR_SWT_COM
+15V
SHUTDOWN/
DISPLAY POWER CONTROL
MONITOR POWER CONTROL
+5V
DISP_EN
HVENBL/
+VSW
LOW_VCC
INFREQ_INT/
BATT_TAP
ISO ±5.9V SUPPLY
5.9V SUPPLIES FOR ISOLATED RS423
T1PIN7
T1PIN8
T1PIN9
VCC
+VSW
ANALOG BOARD
VCC SUPPLY +5.00V
NON-ISO POWER SUPPLIES
ISOLATED POWER SUPPLIES
ISOLATED SUPPLIES
T1
IAG
(ISOLATED GND)
PIN9
PIN8
PIN7
(RS423 POWER)
0696-59
PS_CONTROL
+15V
GND
-15V
DISPL_EN
HVENBL/
SHUTDOWN/
VCC
PWR_SWT_COM
+12V
-175V
+215V
+20
+40
EL DISPLAY POWER SUPPLY
RECHARGER BOARD
BATTERY RECHARGER SUPPLY
POWER SWITCH
F2
+BAT
-BAT
BATTERY
BATT. COMPARTMENT
THERM1
THERM2
VCHG+
VCHG-
POWER ADAPTER

## Monitoring Electronics System Description

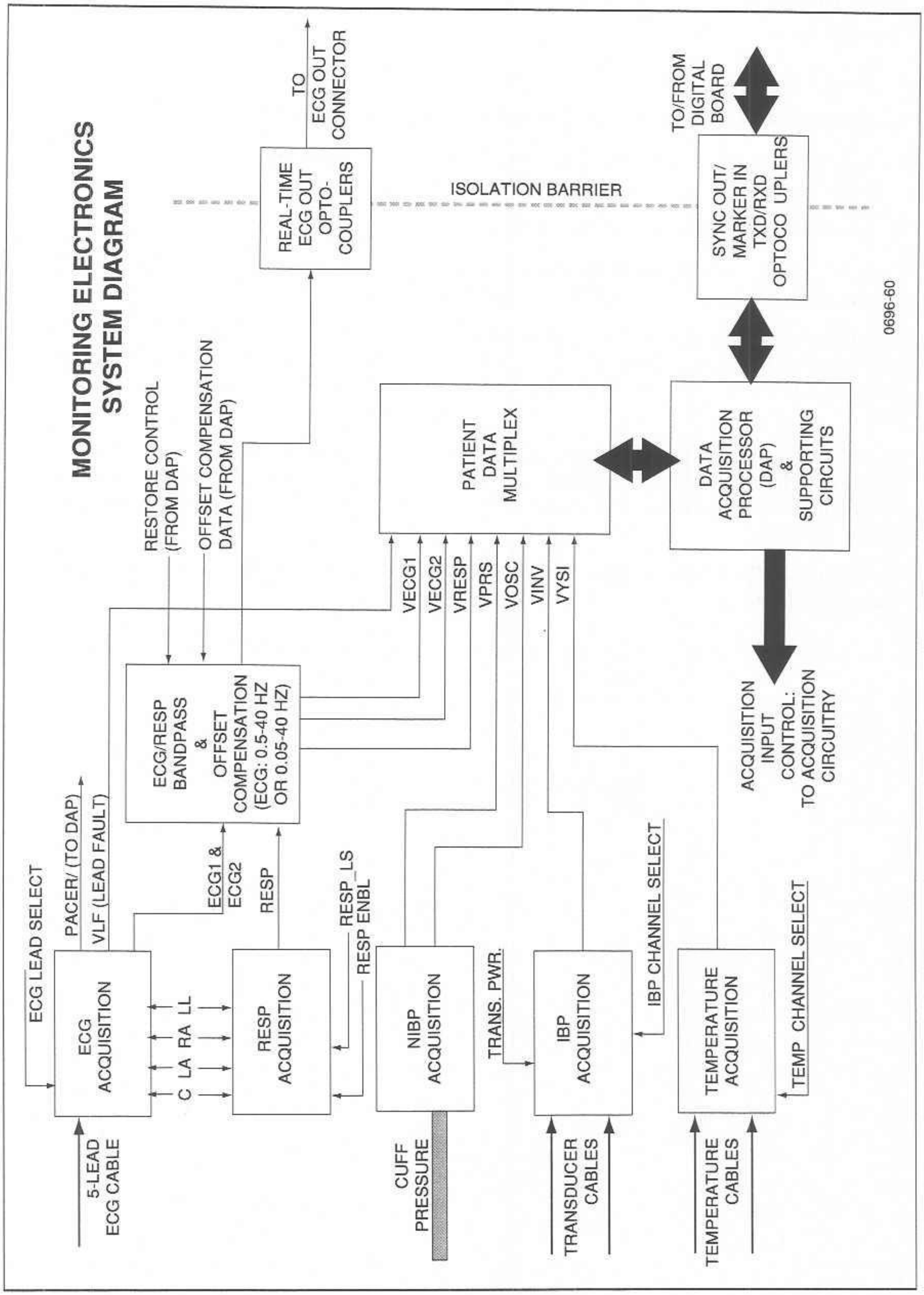
The monitoring electronics reside on the Analog and Digital boards located in the front chassis assembly. Refer to the figure on on page 131.

These circuits

- acquire the physiological signals from coupling devices (electrodes, transducers, and probes)
- convert the analog signal to digital data
- process the data for display and alarm monitoring
- display the data and any alarm conditions
- transmits the analog ECG signal across the isolation barrier for real-time analog ECG output

Isolation barriers on the Analog and Digital boards isolate the circuits connected to the patient from circuits connected to other devices including the monitor's power input. Communications and power delivery across the isolation barrier are achieved using opto-couplers and a transformer rated for medical applications.

Microcontrollers (μCs) control patient data processing, alarm monitoring and display.



MONITORING ELECTRONICS SYSTEM DIAGRAM

5-LEAD ECG CABLE
ECG ACQUISITION
ECG LEAD SELECT
PACER/ (TO DAP)
VLF (LEAD FAULT)
C LA RA LL
ECG1 & ECG2
RESP
RESP ACQUISITION
RESP_LS
RESP ENBL
ECG/RESP BANDPASS & OFFSET COMPENSATION (ECG: 0.5-40 HZ OR 0.05-40 HZ)
RESTORE CONTROL (FROM DAP)
OFFSET COMPENSATION DATA (FROM DAP)
REAL-TIME ECG OUT OPTO-COUPLERS
TO ECG OUT CONNECTOR
ISOLATION BARRIER
CUFF PRESSURE
NIBP ACQUISITION
TRANS. PWR.
TRANSDUCER CABLES
IBP ACQUISITION
IBP CHANNEL SELECT
TEMPERATURE CABLES
TEMPERATURE ACQUISITION
TEMP CHANNEL SELECT
VECG1
VECG2
VRESP
VPRS
VOSC
VINV
VYSI
PATIENT DATA MULTIPLEX
DATA ACQUISITION PROCESSOR (DAP) & SUPPORTING CIRCUITS
ACQUISITION INPUT CONTROL: TO ACQUISITION CIRCUITRY
SYNC OUT/ MARKER IN TXD/RXD OPTOCO UPLERS
TO/FROM DIGITAL BOARD
0696-60

## NIBP Pneumatics Description

The NIBP (cuff) system:

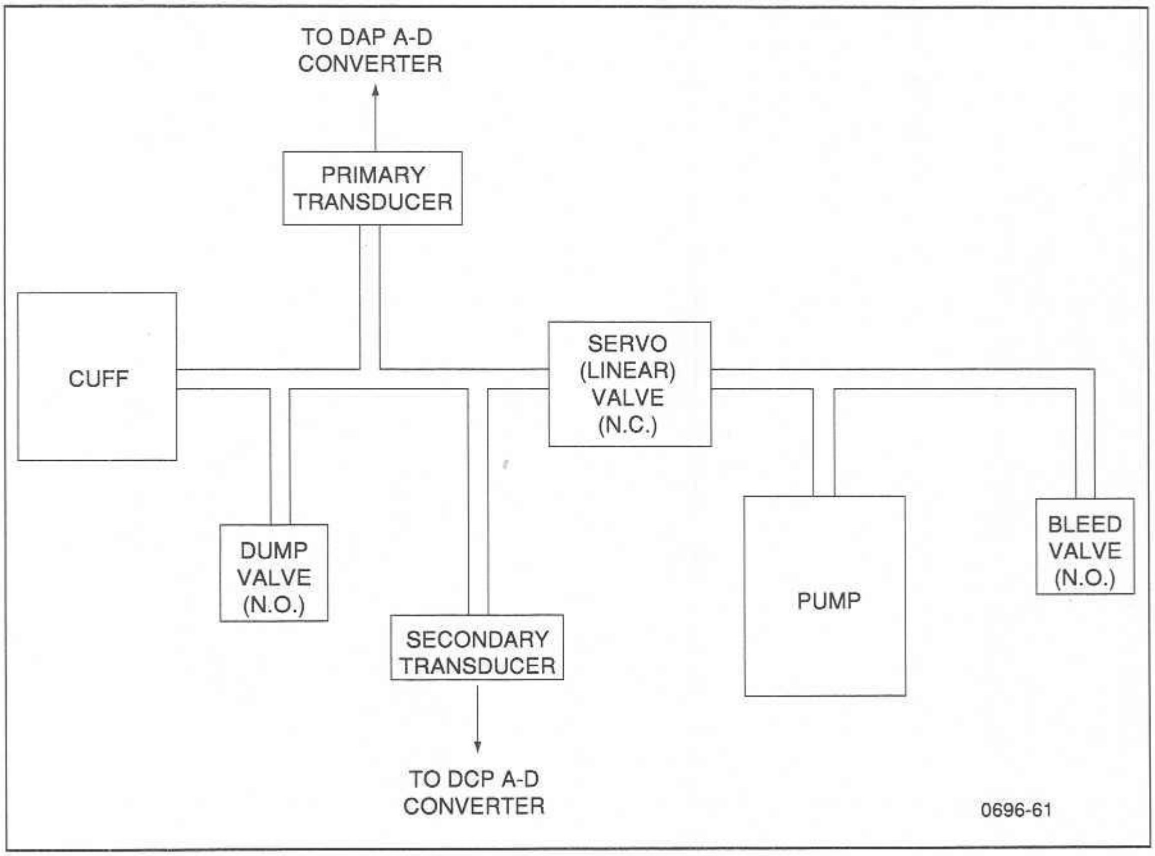
- inflates the cuff to a target cuff pressure
- converts the cuff air pressure to an electrical signal using a pressure transducer
- deflates the cuff in a controlled manner while the monitoring electronics determines blood pressure
- protects the patient from cuff over-inflation

The NIBP air system consists of the pump, air valves, transducers, and the cuff. Except for the primary transducer and cuff, all NIBP pneumatic components are located on the Recharger board.

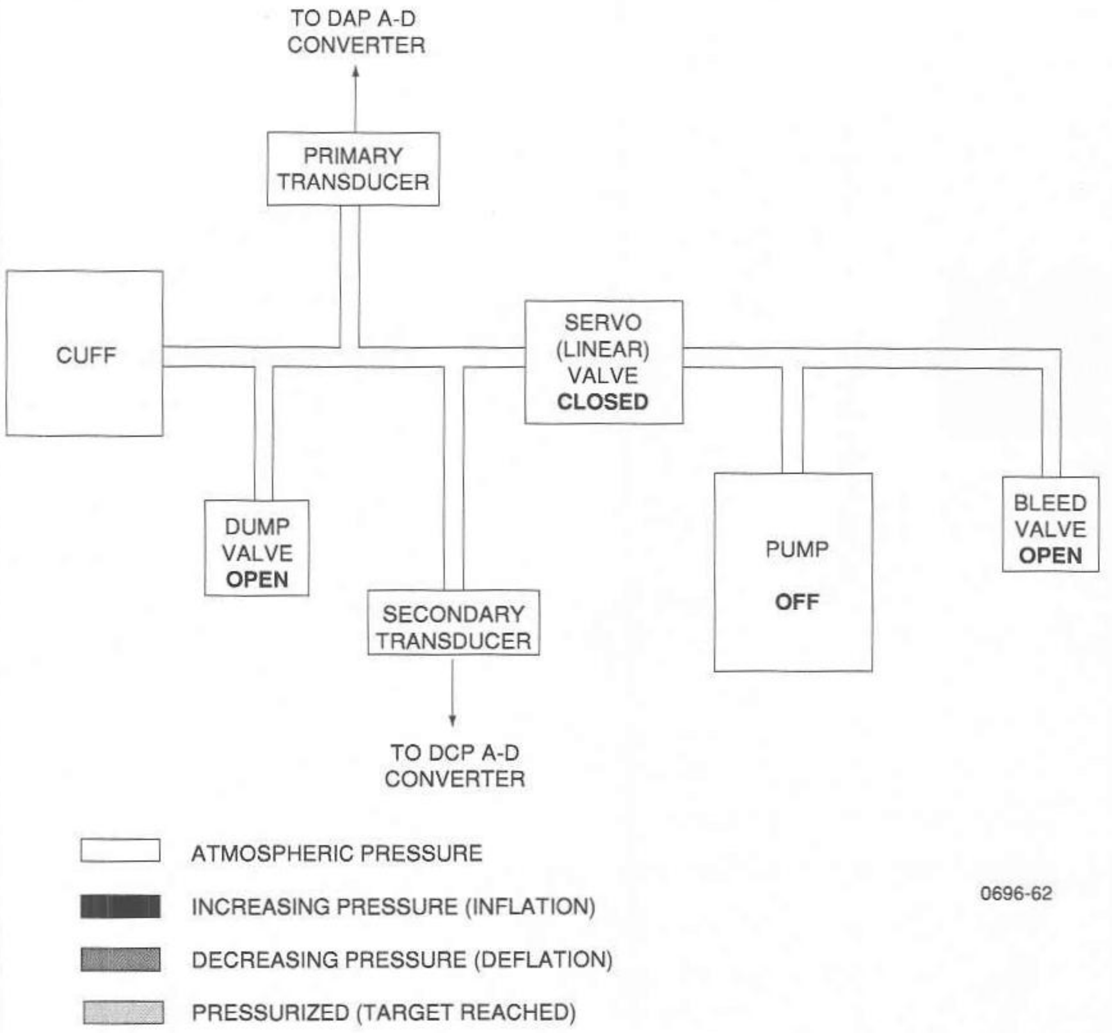
The pump inflates the cuff only when the bleed and dump valves are closed. These two valves are normally open to ensure the NIBP tubing does not remain pressurized when the valves are not energized. The linear valve's programmable iris determines the cuff inflation and deflation (bleed) rate.

Two transducers provide redundancy in pressure monitoring to ensure accurate readings and to ensure cuff deflation in an over-pressure condition. If the cuff pressure reaches the maximum allowable pressure for the patient class (adult, pede, or neonate), the dump valve opens to quickly deflate the cuff.

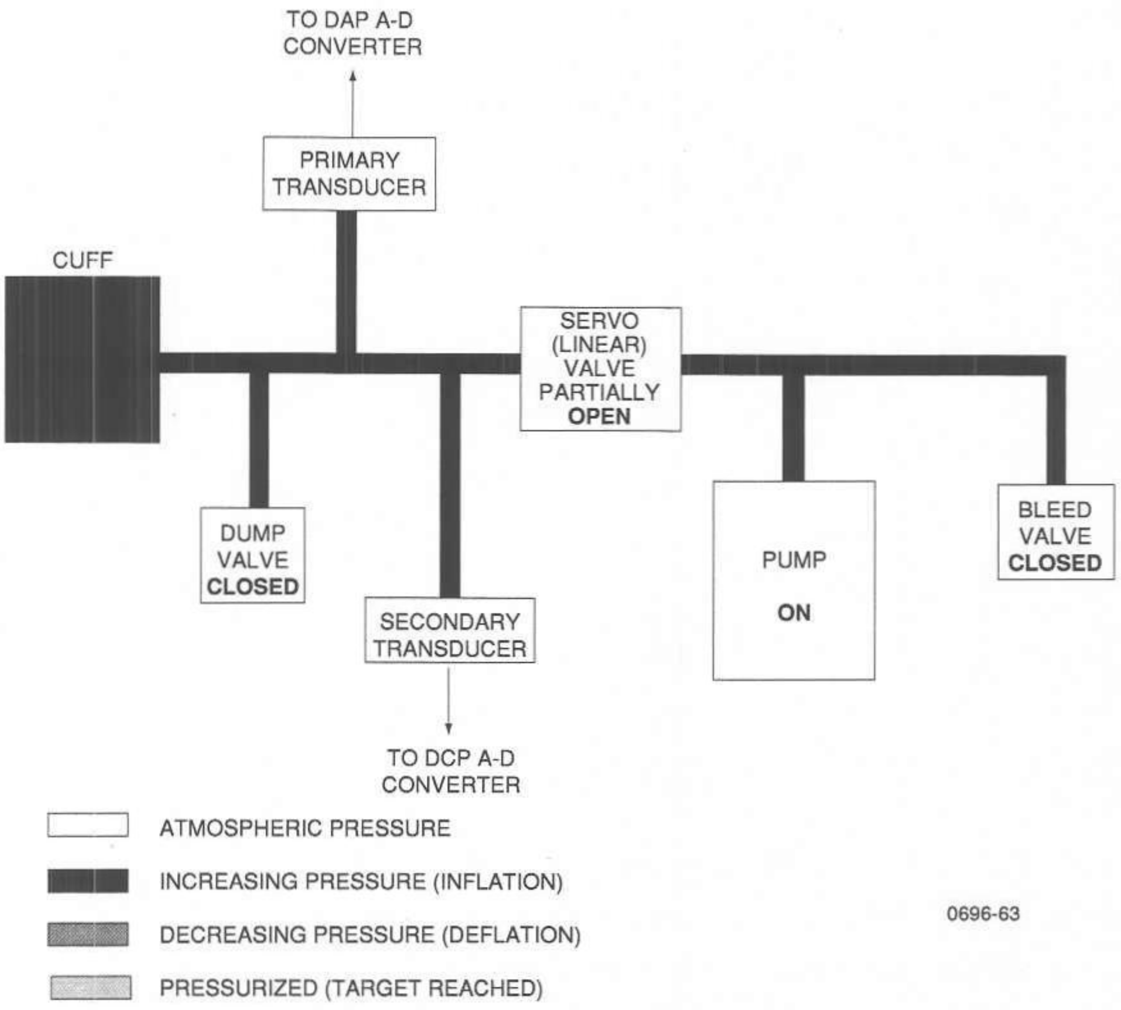
The figures on the following pages illustrate the pressure conditions during a typical NIBP measurement process.

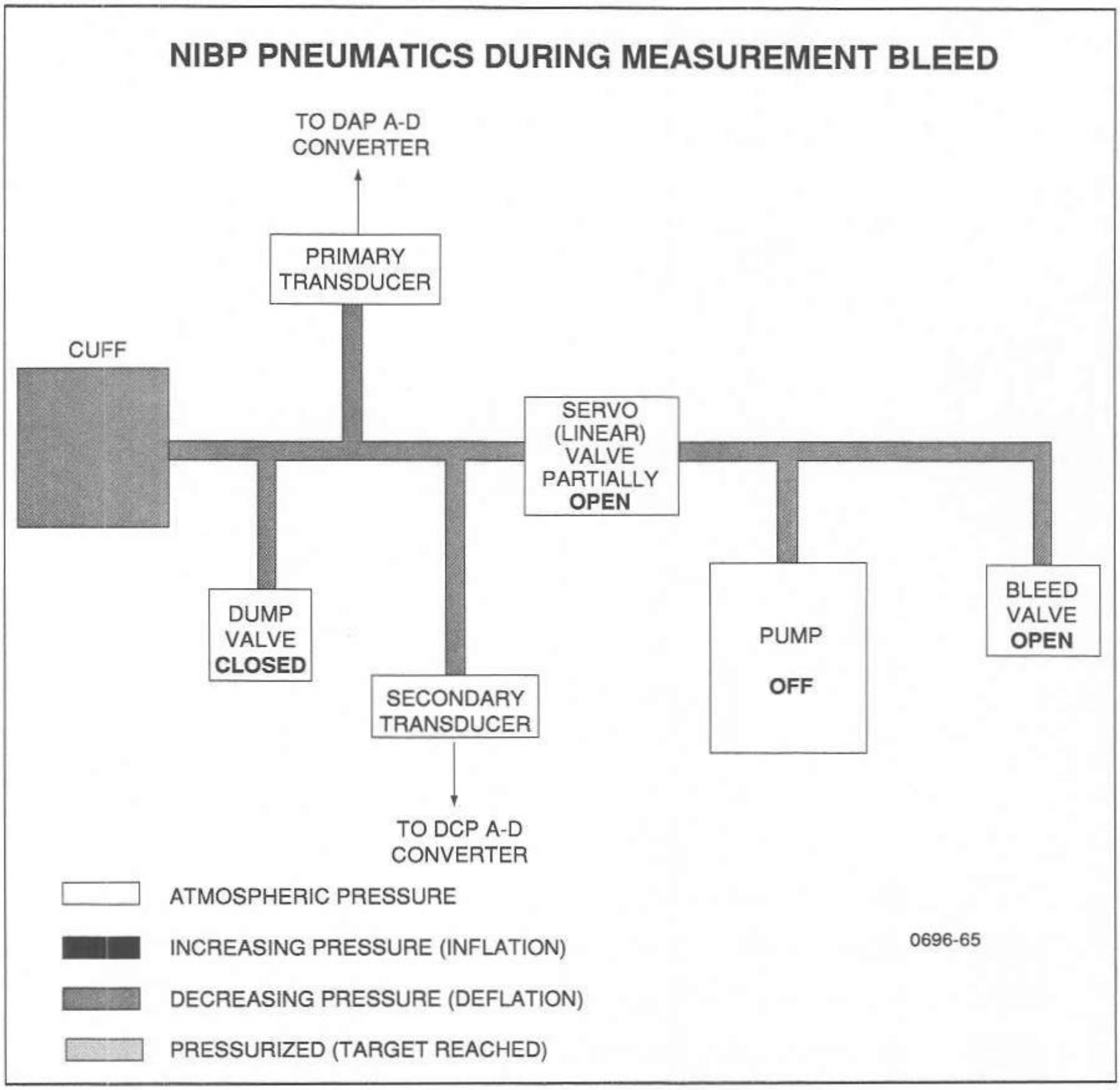

TO DAP A-D CONVERTER
PRIMARY TRANSDUCER
CUFF
SERVO (LINEAR) VALVE (N.C.)
DUMP VALVE (N.O.)
SECONDARY TRANSDUCER
PUMP
BLEED VALVE (N.O.)
TO DCP A-D CONVERTER
0696-61

## NIBP PNEUMATICS AT REST BETWEEN MEASUREMENTS


TO DAP A-D CONVERTER
PRIMARY TRANSDUCER
CUFF
SERVO (LINEAR) VALVE CLOSED
DUMP VALVE OPEN
SECONDARY TRANSDUCER
PUMP OFF
BLEED VALVE OPEN
TO DCP A-D CONVERTER
ATMOSPHERIC PRESSURE
INCREASING PRESSURE (INFLATION)
DECREASING PRESSURE (DEFLATION)
PRESSURIZED (TARGET REACHED)
0696-62

**NIBP PNEUMATICS DURING PUMP UP TO TARGET PRESSURE**

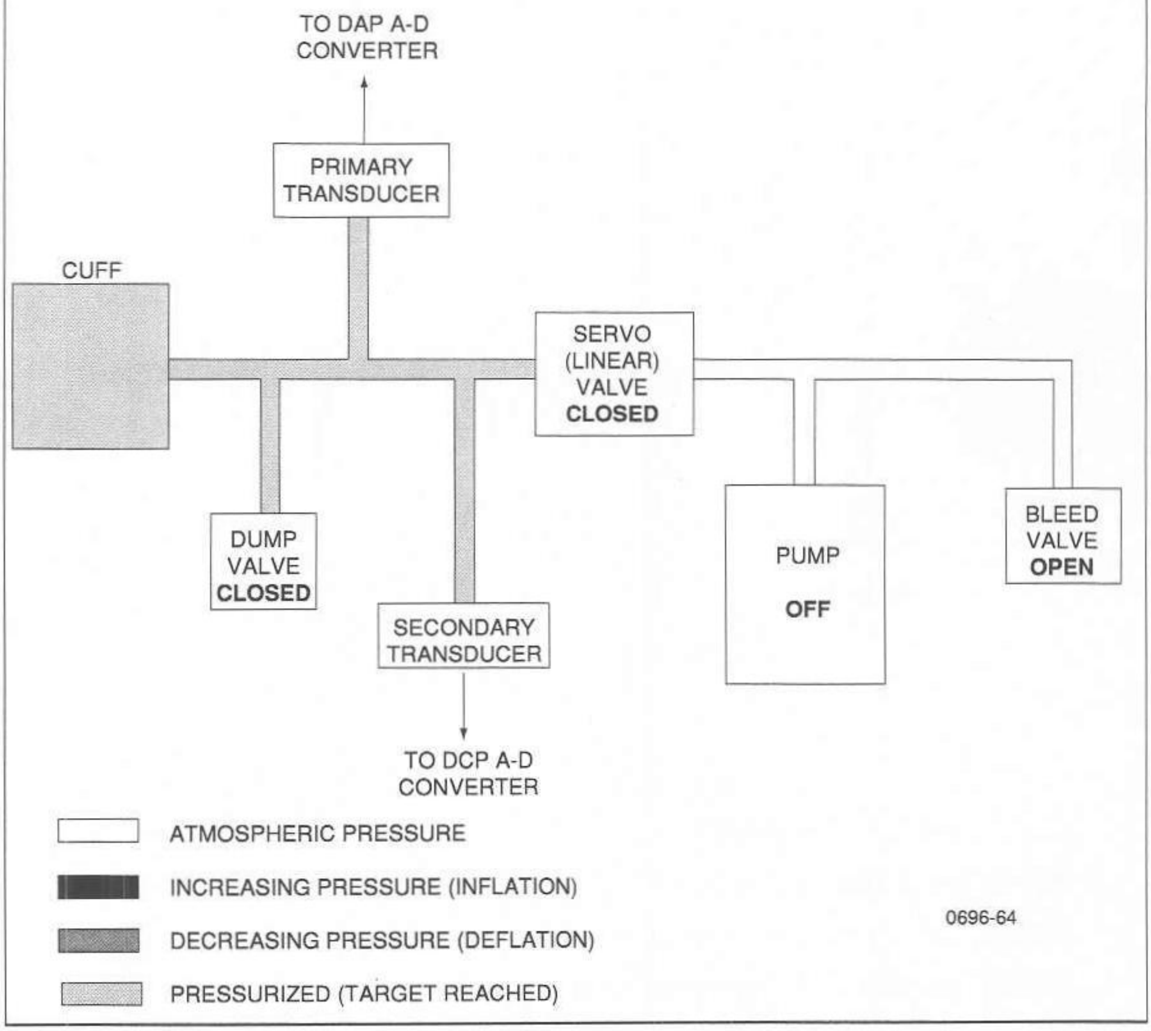

TO DAP A-D CONVERTER
PRIMARY TRANSDUCER
CUFF
SERVO (LINEAR) VALVE PARTIALLY **OPEN**
DUMP VALVE **CLOSED**
SECONDARY TRANSDUCER
TO DCP A-D CONVERTER
PUMP **ON**
BLEED VALVE **CLOSED**
ATMOSPHERIC PRESSURE
INCREASING PRESSURE (INFLATION)
DECREASING PRESSURE (DEFLATION)
PRESSURIZED (TARGET REACHED)
0696-63

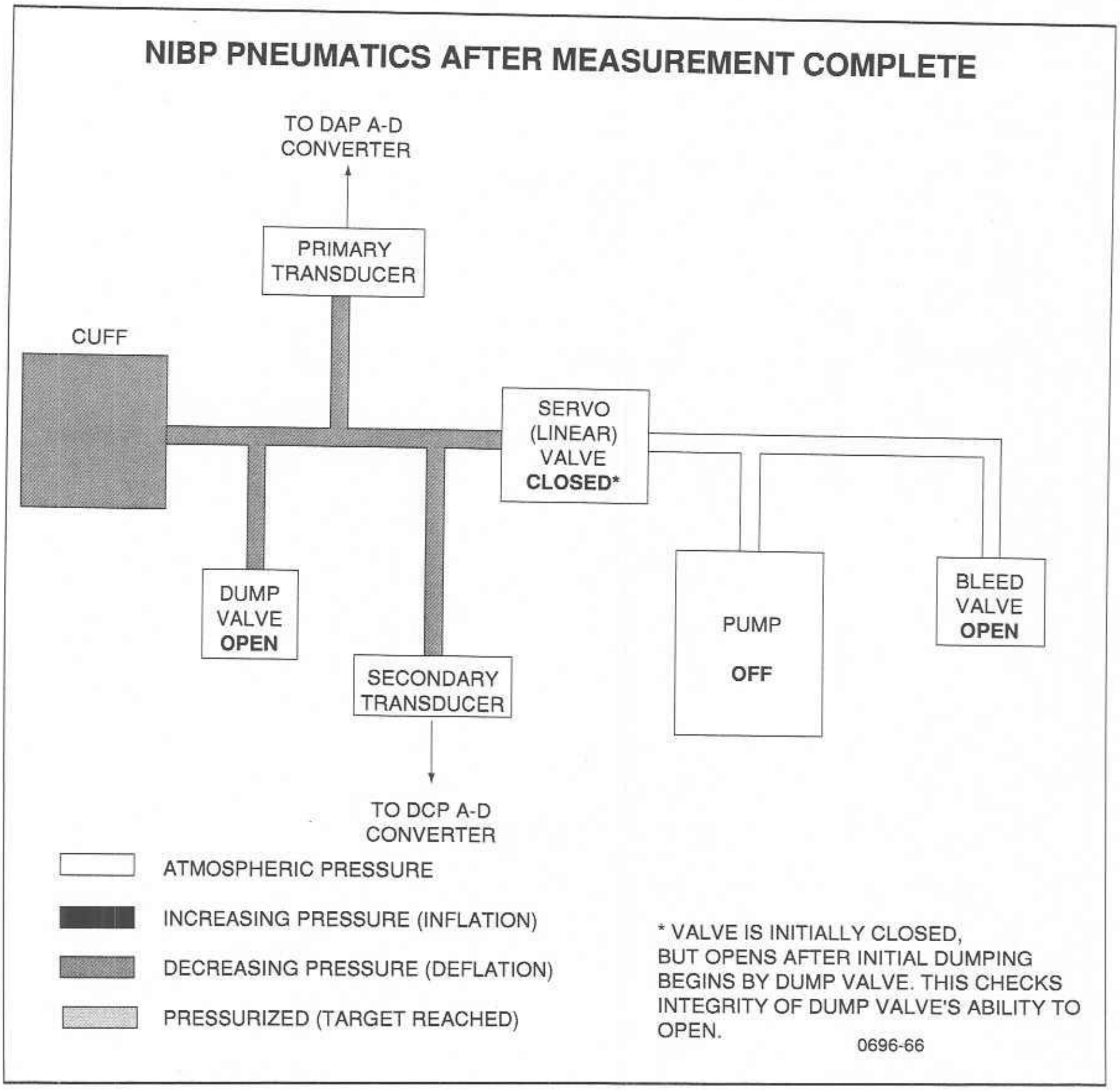


NIBP PNEUMATICS DURING MEASUREMENT BLEED

TO DAP A-D CONVERTER
PRIMARY TRANSDUCER
CUFF
SERVO (LINEAR) VALVE PARTIALLY OPEN
DUMP VALVE CLOSED
SECONDARY TRANSDUCER
PUMP OFF
BLEED VALVE OPEN
TO DCP A-D CONVERTER
ATMOSPHERIC PRESSURE
INCREASING PRESSURE (INFLATION)
DECREASING PRESSURE (DEFLATION)
PRESSURIZED (TARGET REACHED)
0696-65

**NIBP PNEUMATICS AT MAXIMUM TARGET PRESSURE**


TO DAP A-D CONVERTER
PRIMARY TRANSDUCER
CUFF
SERVO (LINEAR) VALVE **CLOSED**
DUMP VALVE **CLOSED**
SECONDARY TRANSDUCER
PUMP **OFF**
BLEED VALVE **OPEN**
TO DCP A-D CONVERTER
ATMOSPHERIC PRESSURE
INCREASING PRESSURE (INFLATION)
DECREASING PRESSURE (DEFLATION)
PRESSURIZED (TARGET REACHED)
0696-64

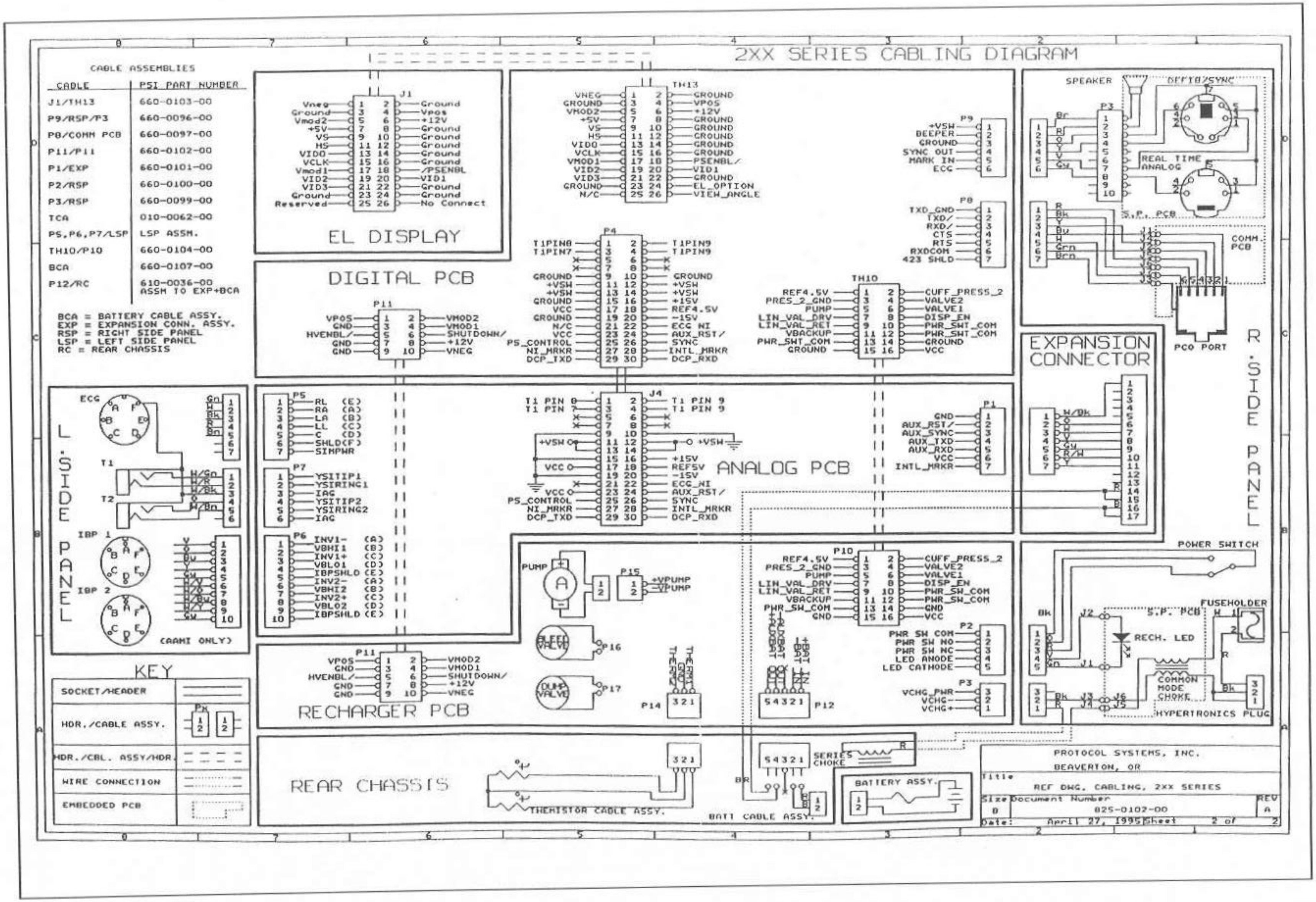

NIBP PNEUMATICS AFTER MEASUREMENT COMPLETE

TO DAP A-D CONVERTER
PRIMARY TRANSDUCER
CUFF
SERVO (LINEAR) VALVE **CLOSED***
DUMP VALVE **OPEN**
SECONDARY TRANSDUCER
PUMP **OFF**
BLEED VALVE **OPEN**
TO DCP A-D CONVERTER
☐ ATMOSPHERIC PRESSURE
■ INCREASING PRESSURE (INFLATION)
▨ DECREASING PRESSURE (DEFLATION)
░ PRESSURIZED (TARGET REACHED)
0696-66

* VALVE IS INITIALLY CLOSED, BUT OPENS AFTER INITIAL DUMPING BEGINS BY DUMP VALVE. THIS CHECKS INTEGRITY OF DUMP VALVE'S ABILITY TO OPEN.

## Cabling Diagrams

The figure on on page 138 shows the system cabling and routing for the monitoring system.


2XX SERIES CABLING DIAGRAM
EL DISPLAY
DIGITAL PCB
ANALOG PCB
RECHARGER PCB
REAR CHASSIS
EXPANSION CONNECTOR
R. SIDE PANEL
L. SIDE PANEL
J1
TH13
P4
J4
TH10
P10
P11
P9
P8
P1
P2
P3
P5
P6
P7
P12
P14
P15
P16
P17
SPEAKER
DEFIB/SYNC
REAL TIME ANALOG
S.P. PCB
COMM. PCB
PCO PORT
POWER SWITCH
FUSEHOLDER
RECH. LED
COMMON MODE CHOKE
HYPERTRONICS PLUG
PUMP
BLEED VALVE
DUMP VALVE
THERMISTOR CABLE ASSY.
BATT CABLE ASSY.
SERIES CHOKE
BATTERY ASSY.
ECG
T1
T2
IBP 1
IBP 2
(AAMI ONLY)
KEY
SOCKET/HEADER
HDR./CABLE ASSY.
HDR./CBL. ASSY/HDR.
WIRE CONNECTION
EMBEDDED PCB
PROTOCOL SYSTEMS, INC.
BEAVERTON, OR
Title
REF DWG. CABLING, 2XX SERIES
Size
B
Document Number
825-0102-00
REV
A
Date: April 27, 1995
Sheet 2 of 2

CABLE ASSEMBLIES

| CABLE | PSI PART NUMBER |
|---|---|
| J1/TH13 | 660-0103-00 |
| P9/RSP/P3 | 660-0096-00 |
| P8/COMM PCB | 660-0097-00 |
| P11/P11 | 660-0102-00 |
| P1/EXP | 660-0101-00 |
| P2/RSP | 660-0100-00 |
| P3/RSP | 660-0099-00 |
| TCA | 010-0062-00 |
| P5,P6,P7/LSP | LSP ASSM. |
| TH10/P10 | 660-0104-00 |
| BCA | 660-0107-00 |
| P12/RC | 610-0036-00<br>ASSM TO EXP+BCA |

BCA = BATTERY CABLE ASSY.
EXP = EXPANSION CONN. ASSY.
RSP = RIGHT SIDE PANEL
LSP = LEFT SIDE PANEL
RC = REAR CHASSIS

## Expansion Module and Printer Description

The printer shares battery power with the monitor, but contains its own power supply. The printer processor communicates with the monitor's processor through the expansion connector and cable.

The Expansion Module is designed to house the Propaq Encore Printer and other circuit boards for additional parameters. The main circuit board in the Printer is the Printer Main Board. An additional circuit board (key panel) in the expansion module with printer front chassis contains the push buttons.

The Printer Main Board is attached to the thermal printer mechanism and should be replaced as a unit with the printer mechanism if repair is needed.

The Printer Main Board connects to the expansion connector, the battery pack, the push buttons on the expansion module front panel, the printer mechanism (motor and print head), and the paper out and head up sensors.

The printer's microprocessor receives print data and control information from the Propaq Encore and sends data to the Encore. Communication between the two systems (Encore and printer CPUs) is done by sending and receiving data packets over serial communication lines.

The print head assembly contains 5 segments consisting of 64 thermal printing dots each for a total of 320 dots, which cover the width of the paper. As the paper moves under the print head, the system enables each segment energizing the thermal dots as necessary.

The Printer Main board consists of five functional blocks: Printer CPU, Printer Driver, Printer Logic, System Power, and Printer Power. These blocks are interconnected by several control lines and buses. External to the Printer Main board are the key panel, housed in the expansion module front chassis, and the printer motor and print head, both parts of the printer mechanism.

The Printer CPU block receives data and control information from the Propaq Encore through the Printer Logic block. The Printer CPU sends data to other printer circuits to control printer functions and sense printer conditions.

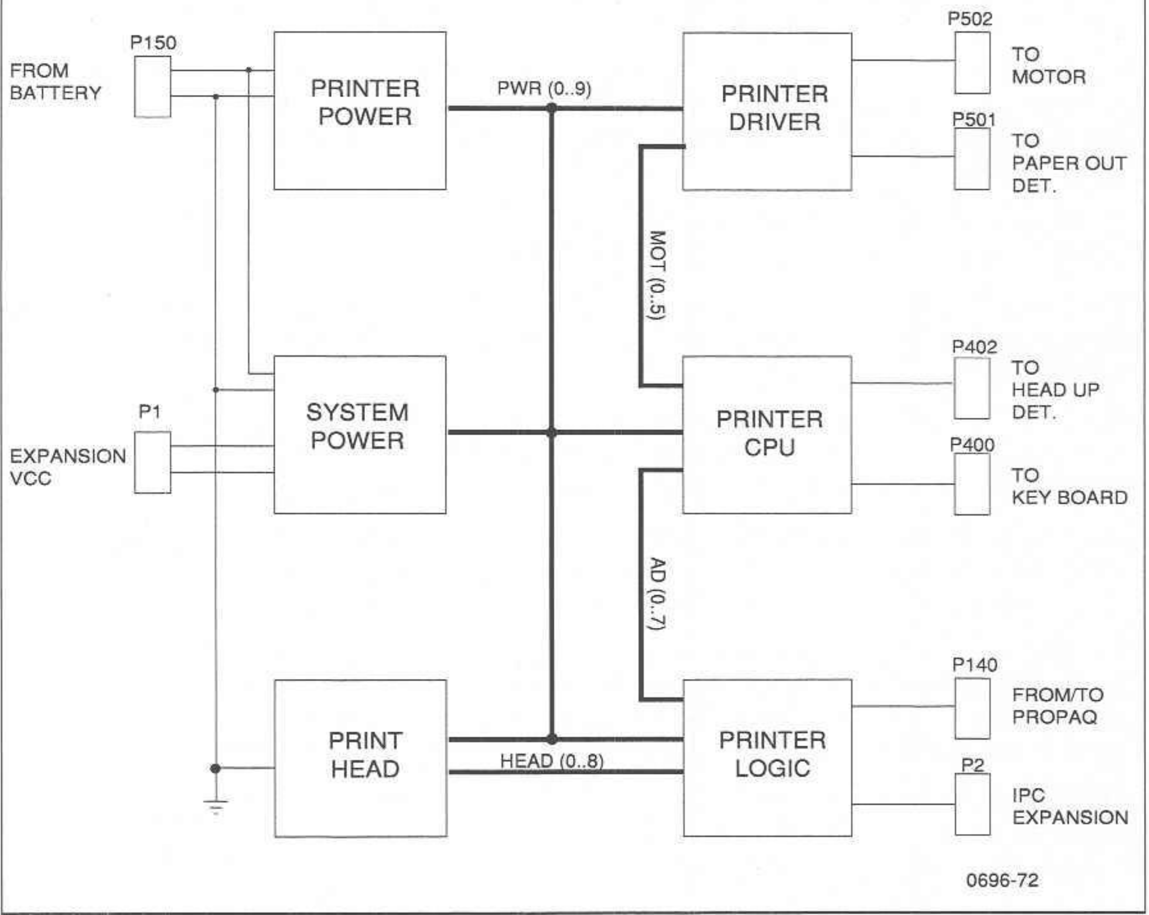
Through the Printer Driver the CPU controls the stepper motor and detects when the paper has run out.

The CPU loads print data into the Printer Logic block and, through this block, controls the individual printhead segments. The CPU also interfaces with the Propaq Encore through this circuitry.

The System Power block provides several dc power supplies to the printer.

The Printer Power block provides the +24V printer power supply.

## PRINTER FUNCTIONAL BLOCK DIAGRAM


P150
FROM BATTERY
PRINTER POWER
PWR (0..9)
PRINTER DRIVER
P502
TO MOTOR
P501
TO PAPER OUT DET.
MOT (0..5)
P1
EXPANSION VCC
SYSTEM POWER
PRINTER CPU
P402
TO HEAD UP DET.
P400
TO KEY BOARD
AD (0..7)
PRINT HEAD
HEAD (0..8)
PRINTER LOGIC
P140
FROM/TO PROPAQ
P2
IPC EXPANSION
0696-72

## Pulse Oximetry Option ($SpO_2$) Description

The Propaq Encore pulse oximetry option ($SpO_2$) hardware includes two circuit boards, a side-panel D connector, and related hardware. The pulse oximetry option is installed either in the pulse oximetry option module attached to the rear of the monitor or in the expansion module when the printer or the $CO_2$ options are also present.

The two circuit boards include the $SpO_2$ Communications Processor (SCP Board) and the $SpO_2$ Board. The $SpO_2$ Board provides all necessary circuitry to receive and process oxygen saturation data from the NELLCOR oxygen sensor. The SCP Board prepares the data for processing by the monitor's processor, and it handles all communications with the monitor. The SCP Board also drives the $SpO_2$ speaker.

The $SpO_2$ option hardware consists of the following items:

- monitor/option interface circuit board (SCP board)
- $SpO_2$ circuit board
- side-panel connector (9-pin D connector)
- $SpO_2$ speaker
- the $SpO_2$ case attached to the rear of the monitor when no expansion module option is also present
- in the case of the printer, the expansion module case attached to the bottom of the monitor

The $SpO_2$ signal provided by the oxygen transducer or sensor is first processed by the $SpO_2$ circuit board where it is converted to digital data, then that data is passed to the SCP board where it is prepared for transmission to the Propaq Encore monitor's main microprocessor.

An $SpO_2$ option isolated power supply, powered by monitor batteries, resides on the SCP board, supplying power to the $SpO_2$ circuits only. If the $SpO_2$ option is part of the expansion module, the $SpO_2$ power supply does not provide power to the printer in the expansion module. The printer circuit board provides power to the printer.

A connector on the side panel allows connection of an oxygen transducer (to the 9-pin D-type connector) directly to the Propaq Encore.

The NELLCOR oxygen transducer senses oxygen content of functional arteriolar hemoglobin through the use of light passed through the sensor site. The reflective/absorbative characteristics of hemoglobin at the wavelengths used allow the pulse oximetry circuits to obtain changing saturation levels, which can be processed to obtain the oxygen saturation percentage.

Wavelengths in the red and the infrared regions of light are produced by light emitting diodes (LEDs) manufactured to emit light at the required wavelengths. The reflected light is detected by a photo diode, which converts the light to an electrical signal. The LEDs are switched on and off under control of the $SpO_2$ microprocessor. Both are not on at the same time. As the system receives the signal from the photo diode, it knows whether the signal was derived from the red or infrared LED. Because the photo diode is sensitive to light emitted from sources other than the LEDs (ambient light), an ambient light component is subtracted from the signal during the processing of the $SpO_2$ data.

An internal calibration resistor in the transducer is used to identify the wavelengths of light produced by the LEDs. This information is required for proper processing of the $SpO_2$ data.

note...

**The oxygen transducers are not serviceable units.**

The figure on on page 143 shows a functional block diagram of the $SpO_2$ circuit board. The $SpO_2$ board consists of the following subsystems:

- internal preamplifier and switch
- ac-coupled amplifier
- inverting amplifier with variable gain stage
- synchronous detector
- splitter
- 5-pole low pass filters
- 16-bit ADC
- internal calibration amplifier
- CPU/Control
- LED current drivers
- compare amplifiers

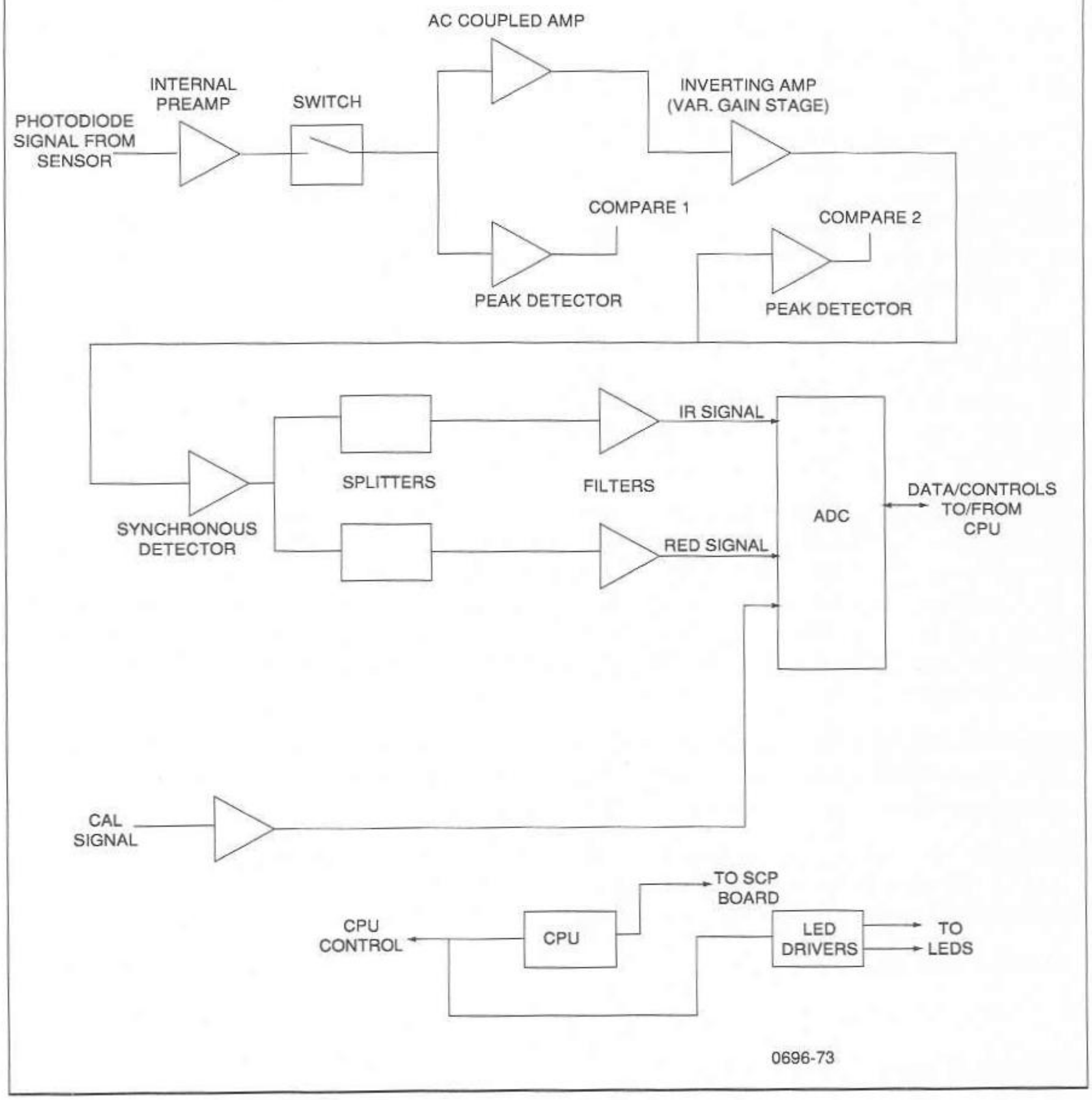
The CPU detects the presence of a transducer plugged into the D-type connector. Switch S1 routes the signal from the preamplifier to the ac-coupled amplifier. The input signal is ac-coupled to remove any dc offset present. The result is a pulse waveform representing light levels from three sources: red LED, infrared (IR) LED, and ambient. An inverting amplifier with a variable gain stage scales the signal to allow processing the best available pulse oximetry information.

Because the CPU controls the LEDS in the sensor, it knows which pulse level of the input waveform represents which wavelength of light. When the red LED is activated, the waveform level indicates red light plus ambient light. When the IR LED is activated, the waveform level indicates IR light plus ambient light. When neither LED is activated, the waveform level indicates ambient light. Only the detected red and IR light levels are used to determine the $SpO_2$ saturation value. The synchronous detector inverts the ambient light signal so that the ambient light signal can be subtracted from the red plus ambient light signal and the IR plus ambient light signal.

The pulses are filtered through 5-pole filter networks to remove the signal components above about 20Hz. The resulting signals indicate the detected RED and IR light levels and can then be digitized. The data from the ADC is processed by the CPU and then sent to the SCP board for transmission to the Propaq Encore monitor's CPU.

$SpO_2$ signal level is controlled through the variable gain stage of the inverting amplifier and the output current of the LED current driver. By controlling both signal gain and current drive, the CPU can maintain the best possible signal level for processing. Amplifiers sense the $SpO_2$ signal levels at two points, directly sending their outputs to the CPU. The CPU monitors these levels as it sets the gain stages of the inverting amplifier and LED current driver.

## PULSE OXIMETRY BLOCK DIAGRAM


AC COUPLED AMP
INTERNAL PREAMP
SWITCH
INVERTING AMP (VAR. GAIN STAGE)
PHOTODIODE SIGNAL FROM SENSOR
COMPARE 1
COMPARE 2
PEAK DETECTOR
PEAK DETECTOR
IR SIGNAL
SPLITTERS
FILTERS
ADC
DATA/CONTROLS TO/FROM CPU
SYNCHRONOUS DETECTOR
RED SIGNAL
CAL SIGNAL
TO SCP BOARD
CPU CONTROL
CPU
LED DRIVERS
TO LEDS
0696-73

## Capnography ($CO_2$) Description

Two capnography ($CO_2$) monitoring options are available—the mainstream -sampling $CO_2$ option ($MCO_2$) and the sidestream-sampling $CO_2$ option ($SCO_2$).

Both mainstream $CO_2$ and sidestream $CO_2$ options are available in one product. However, only one sampling method may be monitored at any time—simultaneous monitoring of $MCO_2$ and $SCO_2$ is not supported.

The mainstream $CO_2$ circuit board (MSP) supports all mainstream and Sidestream applications and is the major interface between the printer and $SpO_2$ hardware in certain configurations of the Expansion Module. The MSP board replaces the SCP board in $SpO_2$ applications with $CO_2$. For sidestream-only applications, an MSP board version without mainstream hardware is used. For both mainstream and sidestream applications, the MSP board is mounted within the rear panel of the Expansion Module housing.

**Mainstream $CO_2$Option.** In the mainstream sampling method, the $CO_2$ analysis chamber (commonly referred to as the "bench") is an integral part of the mainstream sensor which is located in-line, between the patient's airway and the ventilator circuit via an airway adapter. The patient's expired gas is sampled directly from the patient's airway. The MSP board interfaces the external mainstream sensor to the Propaq monitor.

**Sidestream $CO_2$ Option.** In the Sidestream sampling method, the bench is located on the Stick board within the Propaq monitor. A sample of the patient's expired gas is aspirated from the airway and is drawn to the bench through a sampling line containing a water trap. The Stick board also contains pneumatic tubing that connects to the SSP board. The Stick board is mounted on the Sidestream Processor board assembly (SSP board) which interfaces the Stick board to the Propaq monitor. The SSP/Stick board assembly is mounted within the front bezel of the Expansion Module housing of the Propaq monitor.

**System Interface.** The SSP board power and communication is obtained via the extender board that connects to the MSP board. The extender board routes datalines from the MSP board and contains additional power supplies for powering the $SCO_2$ boards.

The Main Stream Processor circuit board (MSP board) is the major interface connection between several subsystems in the Expansion Module. This circuit board connects directly to the expansion connector, providing a direct interface to a Propaq Encore Display Processor system.

The MSP board also supports:

- Main Stream $CO_2$
- an interface to the $SpO_2$ system
- an interface to the Printer option
- an interface to sidestream $CO_2$

## Mainstream Board

The MSP board is divided into isolated and non-isolated circuitry. See the figure below.

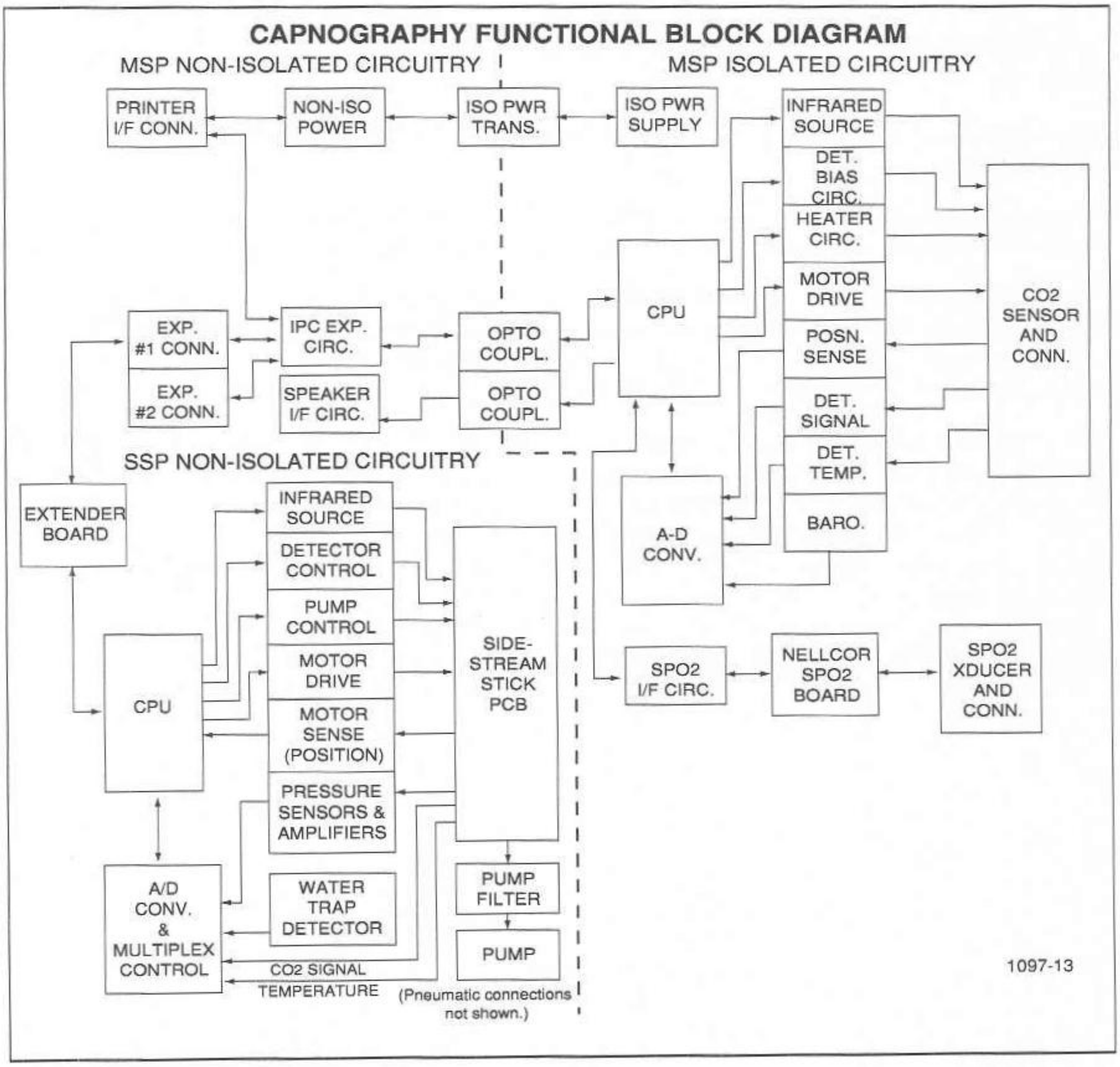
**Non-Isolated Circuitry.** The Non-Isolated circuitry on the MSP board interfaces with the Propaq Encore, the printer, the speaker, P6 and P7 expansion connectors, and with the Main Stream Processor which resides on the isolated section of the MSP board.

**Isolated Circuitry.** The Isolated Circuitry directly controls the hardware responsible for the $CO_2$ measurement function.

**CPU Circuitry.** The CPU Circuitry includes the Philips 80C552 micro controller, 32K of RAM, 64K of ROM, and standard RESET circuitry.

A UART directly interfaces with the Nellcor $SpO_2$ board providing the $SpO_2$ measurement function.

The $CO_2$ and $SpO_2$ functions are isolated from all other subsystems in the Propaq Encore or Expansion modules, but not from each other.


CAPNOGRAPHY FUNCTIONAL BLOCK DIAGRAM

MSP NON-ISOLATED CIRCUITRY
MSP ISOLATED CIRCUITRY
PRINTER I/F CONN.
NON-ISO POWER
ISO PWR TRANS.
ISO PWR SUPPLY
INFRARED SOURCE
DET. BIAS CIRC.
HEATER CIRC.
MOTOR DRIVE
POSN. SENSE
DET. SIGNAL
DET. TEMP.
BARO.
CO2 SENSOR AND CONN.
CPU
A-D CONV.
EXP. #1 CONN.
EXP. #2 CONN.
IPC EXP. CIRC.
SPEAKER I/F CIRC.
OPTO COUPL.
OPTO COUPL.
SSP NON-ISOLATED CIRCUITRY
EXTENDER BOARD
INFRARED SOURCE
DETECTOR CONTROL
PUMP CONTROL
MOTOR DRIVE
MOTOR SENSE (POSITION)
PRESSURE SENSORS & AMPLIFIERS
WATER TRAP DETECTOR
SIDE-STREAM STICK PCB
PUMP FILTER
PUMP
CPU
A/D CONV. & MULTIPLEX CONTROL
CO2 SIGNAL
TEMPERATURE
(Pneumatic connections not shown.)
SPO2 I/F CIRC.
NELLCOR SPO2 BOARD
SPO2 XDUCER AND CONN.
1097-13

## IPC Expansion

The Inter-processor Communications (IPC) bus, originating in the Propaq Encore, is passed to the MSP board from the expansion connector. The two-wire bus is expanded to the printer and to the Main Stream Processor via opto-couplers.

## Power Distribution System

Power for $CO_2$ and $SpO_2$ circuit operations is derived solely from the expansion Connector. The principal supply comes from the Propaq Encore battery connections and an on-board switching power supply.

## $CO_2$ Analysis Chamber (Bench)

Analysis of the expired $CO_2$ occurs in the bench. The bench is located in the mainstream sensor for $MCO_2$ or on the sidestream stick board for $SCO_2$.

In mainstream applications, the sensor mounts over, and connects to, a disposable airway adapter (cuvette) through which the patient's exhaled gases flow. In sidestream applications, a sample of exhaled gases is obtained through a small diameter sampling tube and routed to the bench located on the Stick board.

Unless otherwise noted, the following details are common for bench operation in both sampling methods.

The bench consists of infrared (IR) light source and filter, a revolving chopper wheel, and a photodetector.

The chopper wheel is an aluminum disk containing a sealed $CO_2$ reference cell, an open slot, and a light-blocking area. The chopper wheel spins in the direct path of the IR light source.

The IR source is located on one side of the bench and is projected through the gas sample (in the airway adapter in $MCO_2$; routed directly to the bench in $SCO_2$) to a photodetector at the other side of the bench. As the IR beam passes through the gas sample to the photodetector, the components of the spinning chopper wheel are passed through the beam with each revolution.

The amplified photodetector output signal is modulated by the revolving chopper wheel and is referred to as VSIG. Each rotation of the chopper wheel generates two VSIG peaks of differing size, and a low flat spot. The voltages representing these points are called Vpeakhi, Vpeaklo, and Vdark. These correspond to the open slot, the $CO_2$ reference cell and the light blocking areas on the chopper wheel, respectively. The VSIG output from each complete rotation of the bench chopper wheel, occurring every thirty milliseconds, together with a known bench temperature and calibration constants stored in an EEPROM (located in the mainstream sensor connector or the sidestream Stick PCB), provides all required information to determine the $CO_2$ value.

# Section 7
# Field Replaceable Units (FRUs)

## List of FRUs

The following list identifies the available FRUs for the Propaq Encore. To order an FRU, contact Protocol Systems Technical Support as described in Section 1.

| REPLACEMENT PART DESCRIPTION | PART NO. |
|---|---|
| **MONITOR CIRCUIT BOARD ASSEMBLIES** | |
| ANALOG PCB, < 1.30.00 S.W. VERSION, D-SERIES ONLY | 020-0504-00 |
| ANALOG PCB, > 1.31.00 S.W. VERSION, D-SERIES ONLY | 020-0565-00 |
| ANALOG PCB, D/E-SERIES, > 1.31.00 S.W. VERSION | 020-0577-00 |
| DIGITAL PCB, D-SERIES ONLY | 020-0505-00 |
| DIGITAL PCB, D/E-SERIES | 020-0578-00 |
| RECHARGER PCB, EL, D-SERIES ONLY | 020-0506-00 |
| RECHARGER PCB, EL, D/E SERIES | 020-0576-00 |
| DISPLAY MODULE, EL, HI RESOLUTION | 500-0024-00 |
| **MONITOR FRONT/REAR CHASSIS PARTS** | |
| FRONT CHASSIS | 020-0508-00 |
| REAR CHASSIS | 020-0512-00 |
| CAP, VERTICAL KEY | 630-0093-00 |
| CAP, HORIZONTAL KEY | 630-0087-00 |
| KEY PAD, ELASTOMERIC. | 630-0086-00 |
| **MONITOR SIDE PANELS (LABELS NOT INCL.)** | |
| LEFT SIDE PANEL, AAMI CONNECTORS, ALL MODELS | 010-0138-01 |
| LEFT SIDE PANEL, HP CONNECTORS, ALL MODELS | 010-0157-00 |
| RIGHT SIDE PANEL | 010-0151-00 |
| **NIBP SYSTEM PARTS** | |
| PUMP | 680-0051-00 |
| NIBP PLUMBING, AAMI CONNECTORS, ALL MODELS | 020-0513-00 |

| REPLACEMENT PART DESCRIPTION | PART NO. |
|---|---|
| NIBP PLUMBING, HP CONNECTORS, ALL MODELS | 020-0514-00 |
| CONNECTOR PAIR, CUFF HOSE, QUICK DISCONNECT | 020-0065-00 |
| CONNECTOR, CUFF HOSE, PROPAQ END | 600-0021-00 |
| VALVE, BLEED/DUMP | 680-0050-00 |
| VALVE, LINEAR SERVO | 680-0049-01 |
| INTERNAL TUBING, SILICONE, 2 FEET, 0.104"ID | 008-0009-00 |
| INTERNAL TUBING, SILICONE, 1 FOOT, 0.125"ID | 600-0179-00 |
| **MISC. COMPONENTS FOR MONITOR** | |
| FUSES, 2AG-3A, SLO-BLO | 503-0058-00 |
| FUSE KIT, 3A PICO FUSE, 125V, QTY. 10 | 020-0210-00 |
| FUSE, POWER ADAPTER5X20mm, 400mA, 250V, SLO-BLO | 503-0056-00 |
| FUSE, POWER ADAPTER5X20mm, 800mA, 250V, SLO-BLO | 503-0057-00 |
| SWITCH, ON/OFF, POWER, (W/O BOOT SEAL) | 680-0010-01 |
| FOOT PADS, QTY. 24 | 020-0033-00 |
| HANDLE | 020-0034-00 |
| BOOT SEAL, POWER SWITCH | 680-0006-00 |
| CABLE ASSY., 10-PIN RIBBON, DIGITAL TO RECH. PCB | 660-0102-00 |
| **EXPANSION MODULE/PRINTER OPTION** | |
| PRINTER ASSEMBLY, D-SERIES ONLY | 020-0516-00 |
| PRINTER ASSEMBLY, D-SERIES | 020-0579-00 |
| MAIN CHASSIS, EM W/PRINTER | 020-0520-00 |
| MAIN CHASSIS, EM W/PRINTER (FOR $CO_2$ CONN. PANEL W/O BRACKET) | 020-0581-00 |
| MAIN CHASSIS, EM W/O PRINTER | 020-0521-00 |
| MAIN CHASSIS, EM W/O PRINTER (FOR CO2 CONN. PANEL W/O BRACKET) | 020-0583-00 |
| FRONT PANEL | 020-0515-00 |
| REAR PANEL | 020-0071-00 |
| PAPER DOOR | 020-0074-00 |
| CAP, HORIZONTAL KEY | 630-0087-00 |
| KEY PAD, ELASTOMERIC | 630-0086-00 |
| FUSE, 15A PICO, 125 VOLT, ONE EACH | 503-0019-00 |

| REPLACEMENT PART DESCRIPTION | PART NO. |
|---|---|
| **PULSE OXIMETER OPTION** | |
| MINISOOM BOARD | 020-0473-00 |
| SCP BOARD | 020-0476-00 |
| CHASSIS, OPTION 210 | 020-0122-00 |
| REAR PANEL, OPTION 210 | 020-0123-00 |
| MOUNTING SCREWS/WASHERS | 020-0126-00 |
| SPEAKER PANEL ASSEMBLY | 010-0161-00 |
| CONNECTOR PANEL ASSY. (LOCKING RING NOT INCL.) | 010-0159-00 |
| LOCKING RING, D CONNECTOR | 630-0038-00 |
| **$CO_2$ OPTION MAINSTREAM/SIDESTREAM** | |
| MSP BOARD, OPT. 224, 225, 228, 229, D-SERIES ONLY | 020-0286-50 |
| MSP BOARD, OPT. 224, 225, 228, 229, D-SERIES; ALL E-SERIES $CO_2$ | 020-0580-00 |
| MSP BOARD, OPTIONS 226, 227, D-SERIES ONLY | 031-0058-50 |
| **$CO_2$ OPTION MAINSTREAM** | |
| CONNECTOR PANEL, $CO_2$, (W/ BRACKET) | 020-0285-00 |
| CONNECTOR PANEL, $CO_2$ (W/O BRACKET) | 020-0582-00 |
| $CO_2$ SENSOR | 008-0130-01 |
| **$CO_2$ OPTION SIDESTREAM** | |
| SSP BOARD | 020-0574-00 |
| STICK BOARD | 031-0094-01 |
| EXTENDER BOARD | 031-0092-00 |
| FRONT PANEL, EM, $SCO_2$ | 020-0575-00 |
| **OPTION INTERCONNECT CABLES** | |
| CABLE ASSY., POWER HARNESS, EM | 660-0090-00 |
| CABLE ASSY., PROPAQ P4 TO PCP-P140 | 010-0055-00 |
| CABLE ASSY., PROPAQ P4 TO SCP/MSP-P1 | 010-0048-00 |
| CABLE ASSY., SCP-P4 TO PCP-P140 | 010-0054-00 |
| CABLE ASSY., MSP-P4 TO PCP-P140/KEYPAD TO PCP-P400 | 010-0056-00 |
| **LABELS, ALL LANGUAGE APPLICATIONS** | |
| LABEL, LOGO, PROPAQ ENCORE | 640-0330-03 |

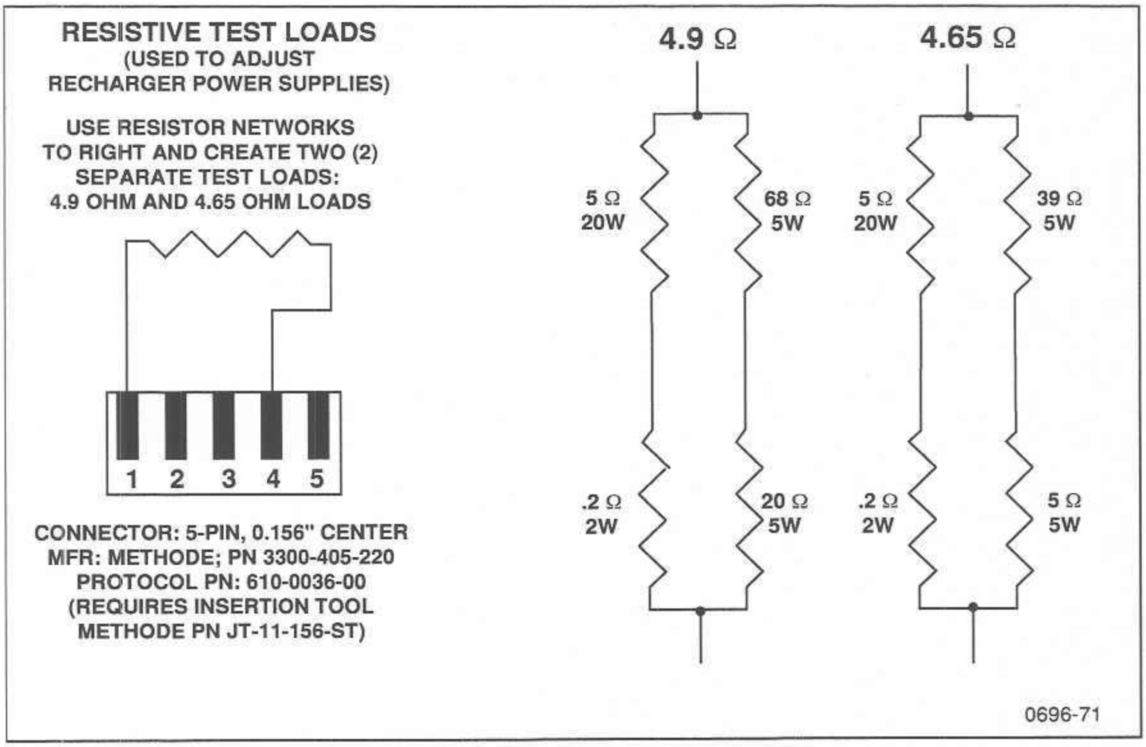
| REPLACEMENT PART DESCRIPTION | PART NO. |
|---|---|
| LABEL, MODEL 202-EL | 640-0350-00 |
| LABEL, MODEL 204-EL | 640-0349-00 |
| LABEL, MODEL 206-EL | 640-0348-00 |
| LABEL, RIGHT SIDE PANEL | 640-0325-00 |
| LABEL, RIGHT SIDE PANEL,ACUITY. | 640-0326-00 |
| LABEL, RIGHT SIDE PANEL, ACUITY, "NETWORKS/ACUITY/MODEM" | 640-0422-00 |
| LABEL, RIGHT SIDE PANEL, PCO, "NETWORKS/ACUITY/MODEM" | 640-0435-00 |
| LABEL, LEFT SIDE PANEL, 202, AAMI, UNIVERSAL | 640-0321-01 |
| LABEL, LEFT SIDE PANEL, 202, HP, UNIVERSAL | 640-0356-01 |
| LABEL, LEFT SIDE PANEL, 202/RESP., AAMI, UNIVERSAL | 640-0329-01 |
| LABEL, LEFT SIDE PANEL, 202/RESP., HP, UNIVERSAL | 640-0355-01 |
| LABEL, LEFT SIDE PANEL, 204, AAMI, UNIVERSAL | 640-0320-01 |
| LABEL, LEFT SIDE PANEL, 204, HP, UNIVERSAL | 640-0354-01 |
| LABEL, LEFT SIDE PANEL, 204/RESP., AAMI, UNIVERSAL | 640-0328-01 |
| LABEL, LEFT SIDE PANEL, 204/RESP., HP, UNIVERSAL | 640-0353-01 |
| LABEL, LEFT SIDE PANEL, 206, AAMI, UNIVERSAL | 640-0319-01 |
| LABEL, LEFT SIDE PANEL, 206, HP, UNIVERSAL | 640-0352-01 |
| LABEL, LEFT SIDE PANEL, 206/RESP., AAMI, UNIVERSAL | 640-0327-01 |
| LABEL, LEFT SIDE PANEL, 206/RESP., HP, UNIVERSAL | 640-0351-01 |
| LABEL, CONNECTOR PANEL, $SpO_2$ | 640-0443-00 |
| LABEL, $SpO_2$ REAR PANEL | 640-0331-01 |
| LABEL, CONNECTOR PANEL, $MCO_2$ | 640-0444-00 |
| LABEL, $SCO_2$ | 640-0416-00 |
| **LABELS, ENGLISH APPLICATIONS** | |
| LABEL, LEFT KEYS/ALARM LEDS | 640-0286-00 |
| LABEL, RIGHT KEYS | 640-0285-00 |
| LABEL, LEFT SIDE PANEL, 202, ADULT/PED., AAMI, INTERIM U.S. | 640-0367-00 |
| LABEL, LEFT SIDE PANEL, 202, ADULT/PED., HP, INTERIM U.S. | 640-0366-00 |
| LABEL, LEFT SIDE PANEL, 204, ADULT/PED., AAMI, INTERIM U.S. | 640-0368-00 |
| LABEL, LEFT SIDE PANEL, 204, ADULT/PED., HP, INTERIM U.S. | 640-0365-00 |
| LABEL, LEFT SIDE PANEL, 206, ADULT/PED., AAMI, INTERIM U.S. | 640-0369-00 |
| LABEL, LEFT SIDE PANEL, 206, ADULT/PED., HP, INTERIM U.S. | 640-0364-00 |

| REPLACEMENT PART DESCRIPTION | PART NO. |
|---|---|
| LABEL, PRINTER, KEY PANEL | 640-0332-00 |
| **LABELS, FRENCH APPLICATIONS** | |
| LABEL, LEFT KEYS/ALARM LEDS, FRENCH | 640-0378-00 |
| LABEL, RIGHT KEYS, FRENCH | 640-0375-00 |
| LABEL, PRINTER, KEY PANEL, FRENCH | 640-0372-00 |
| **LABELS, GERMAN APPLICATIONS** | |
| LABEL, LEFT KEYS/ALARM LEDS | 640-0379-00 |
| LABEL, RIGHT KEYS | 640-0376-00 |
| LABEL, PRINTER, KEY PANEL | 640-0373-00 |
| **LABELS, JAPANESE APPLICATIONS** | |
| LABEL, LOGO, 202, JAPANESE ONLY | 640-0393-00 |
| LABEL, LOGO, 204, JAPANESE ONLY | 640-0394-00 |
| LABEL, LOGO, 206, JAPANESE ONLY | 640-0395-00 |
| **LABELS SPANISH APPLICATIONS** | |
| LABEL, LEFT KEYS/ALARM LEDS | 640-0393-00 |
| LABEL, RIGHT KEYS | 640-0394-00 |
| LABEL, PRINTER, KEY PANEL | 640-0395-00 |
| **SPECIAL SERVICE TOOLS** | |
| NIBP CALIBRATION SETUP TUBING ADAPTER KIT | 008-0012-00 |

# Appendix A
# Manufacturable Test Equipment

## Introduction

The following device(s) can be manufactured for use in the functional verification and calibration procedures in this manual. Parts are readily available from electronic component suppliers.



**RESISTIVE TEST LOADS**
(USED TO ADJUST
RECHARGER POWER SUPPLIES)

USE RESISTOR NETWORKS
TO RIGHT AND CREATE TWO (2)
SEPARATE TEST LOADS:
4.9 OHM AND 4.65 OHM LOADS

CONNECTOR: 5-PIN, 0.156" CENTER
MFR: METHODE; PN 3300-405-220
PROTOCOL PN: 610-0036-00
(REQUIRES INSERTION TOOL
METHODE PN JT-11-156-ST)

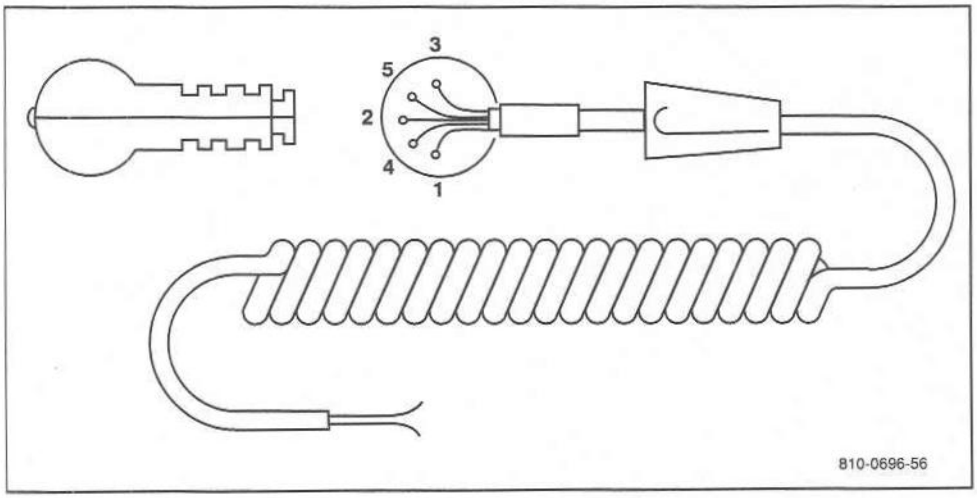
0696-71

# Appendix B Dynatech/Nevada Patient Simulator Modification

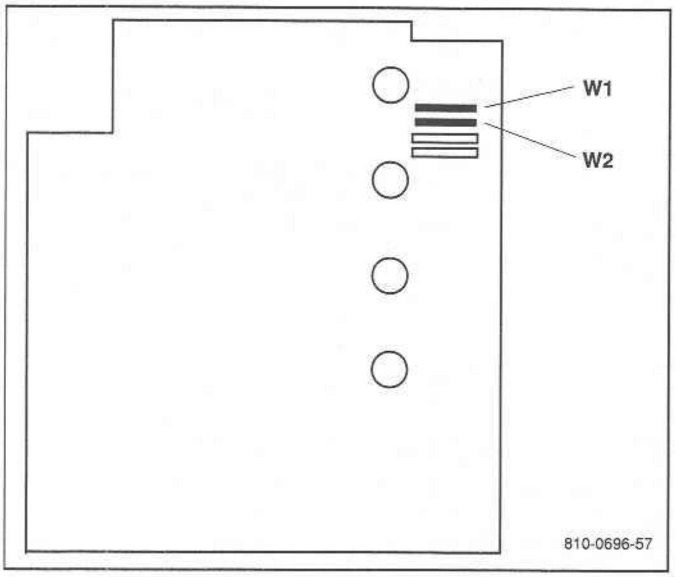
## Introduction

The factory configuration of the Dynatech/Nevada model 214A, 215A, and 217A Patient Simulators is incompatible with the Propaq Encore monitors with IBP channels when both the ECG and invasive pressure simulator channels are simultaneously connected to the monitor. Erroneous readings result. The patient simulator must be modified as described in this appendix in order to use both simulator channels with the Propaq Encore monitors with IBP. If only one simulator channel is used, the modification is unnecessary.

Modify the patient simulator's invasive pressure cable as shown in the figure below.



Remove jumpers W1 and W2 from the patient simulator's Top PCB.



Incompatibilities with other simulators may also cause erroneous readings and/or missing ECG. Check Propaq Encore readings with the simulator against a known source before using the simulator for calibration.

| Function | Color | Pin No. | Encore 204/206 |
|---|---|---|---|
| Output (+) | Black | 4 | C |
| Output (-) | Red | 1 | A & E |
| Exciter (+) | White | 3 | B |
| Exciter (-) | Green | 5 | D |
| ECG Ref | Blue | 2 | No Connection |

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